THE REFINER AND NATURAL GASOLINE MANUFACTURER

In This Issue

Western Petroleum Refiners Association Annual Convention at Fort Worth

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By Roye Munsell

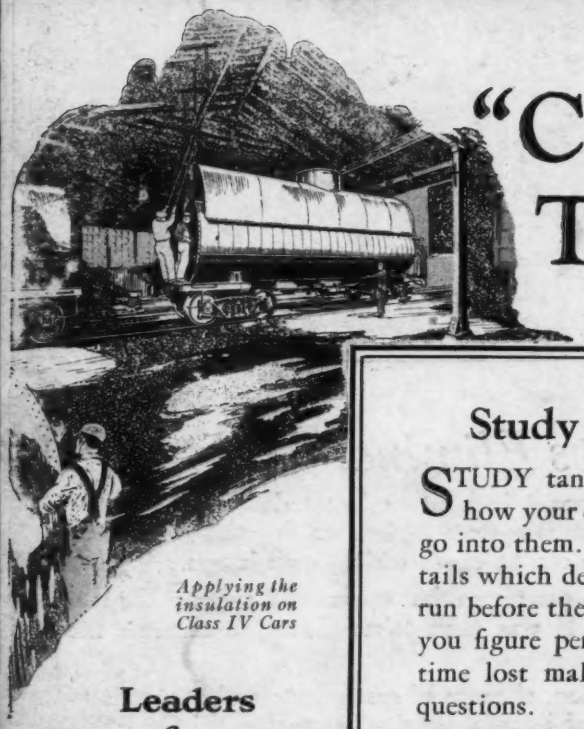
Decreasing Refiner Evaporation Losses
By Ludwig Schmidt

Sample Taking in the Oil Industry
By Ismar Ginsberg

Petroleum Specifications and Tests
By [illegible]

THE JOHN CRERAR LIBRARY MAR 8 1926

Vol. 5 No. 3 MARCH, 1926 $1.00 Per Year



Applying the insulation on Class IV Cars

Leaders for Over 60 Years

"Car Foundry" TANK CARS

Study the Specifications

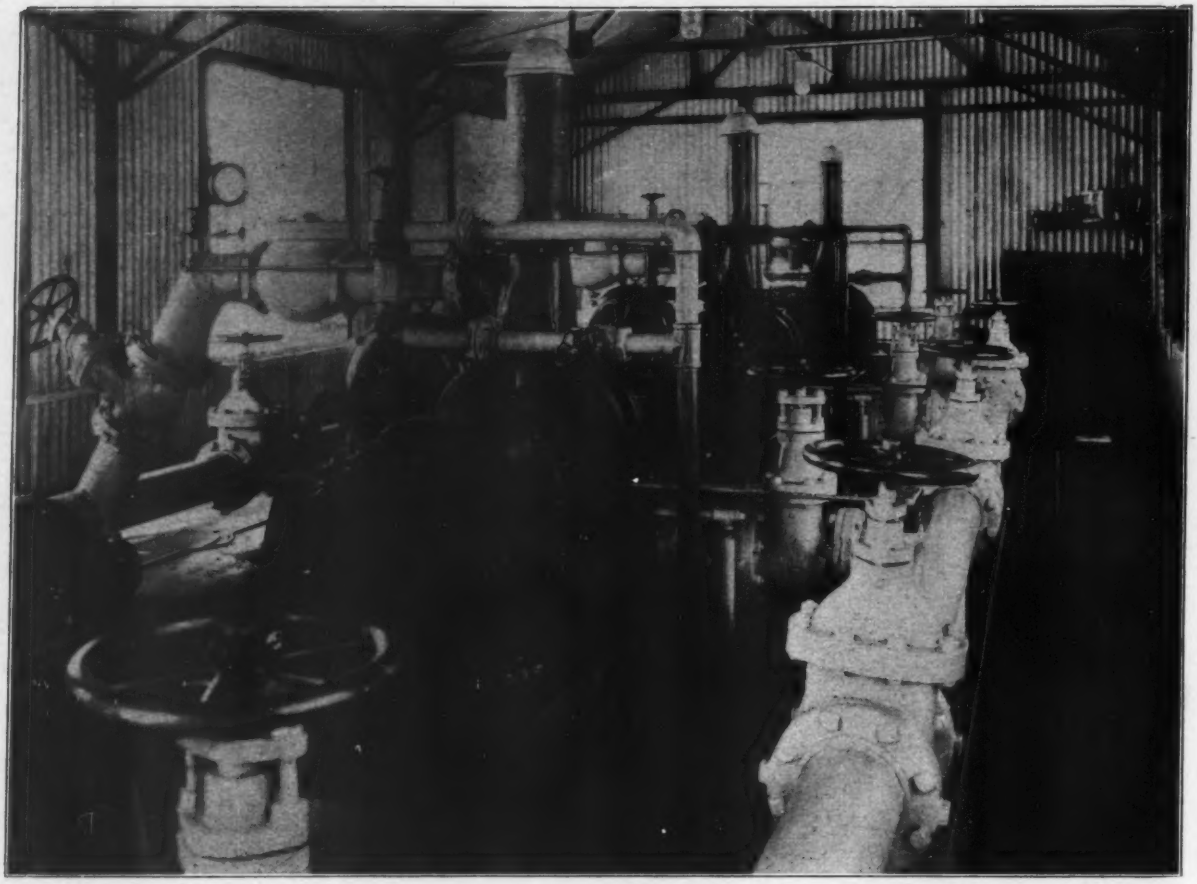
STUDY tank car specifications. Find out how your cars are built and what materials go into them. Give some thought to the details which determine how long your cars will run before they need repairing. How much do you figure per year for repairs? How much time lost making them? Consider all these questions.

Isn't it worth your time to get "Car Foundry" specifications—to make a few comparisons? It need not cost you one cent: just wire collect to the nearest office listed below. Then, *study the specifications.*

Always Get a "Car Foundry" Quotation

American Car and Foundry Company

165 Broadway, New York — Railway Exchange Building, Chicago — 915 Olive Street, St. Louis



Roots Rotary Pumps in service at the Skelly gasoline plant, Lyman, Okla.

Roots Pumps Eliminate Shutdowns

All Roots equipment is built to last indefinitely. When necessary Roots Pumps operate 24 hours a day throughout the year. Adjustments can be made while pump is operating.

We know of one gas pump that operated 8 years without a forced shutdown. It was then taken down to remove the sulphur.

Sturdy construction, absence of small parts and contact surfaces, elimination of internal lubrication makes this long life possible.

You have only to buy one Roots Pump—they last a lifetime.

Write for Bulletin No. 113

ROOTS

You should have the following bulletins in your files:

113—Roots Rotary Pumps.

108—Roots Rotary Gas Pumps.

111—Roots Positive Displacement Gas Meters.

118—Engineering Tables.

Just ask the nearest office for them.

The P.H.&F.M. ROOTS CO.

DEPT. 10

CONNERSVILLE, IND.

Chicago Office
130 S. Michigan Ave.

New York Office
Room 800-120 Liberty St.

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

(245)

Here's What Happens When Rust Gets A Chance

A tank roof honeycombed with rust holes—evaporation losses many times multiplied—early repairs, if not a gauger drowned, or replacement of the entire roof.

That's why you should paint the underside of your tank roofs.

Back of Degraco Tank Paints stands the integrity of the maker—thirty-five years of close contact with paint problems. A definite knowledge of the service conditions to be met and how to meet them are the basic reasons for their wide and successful use in the oil industry.

You can bank on Degraco Paints to cut down corrosion losses.

DEGRACO PAINTS

All Colors for Your Particular Needs

MADE BY

Detroit Graphite Company

512 Twelfth Street

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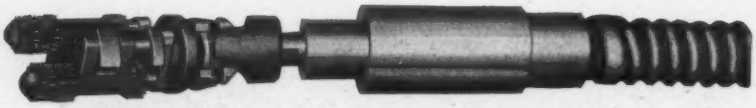
Detroit Graphite Co.
512-12th. St.
Detroit, Mich.

DEGRACO PAINTS ARE SOLD THROUGH BRANCH OFFICES WITH WAREHOUSE STOCKS IN ALL PRINCIPAL CITIES

MANUFACTURED IN CANADA BY DOMINION PAINT WORKS, LIMITED, WALKERVILLE, CANADA

For Tubes or Pipes–Large or Small



Lagonda No. D-153 Cleaner for 2-inch curved pipe, as used in the residuum lines.

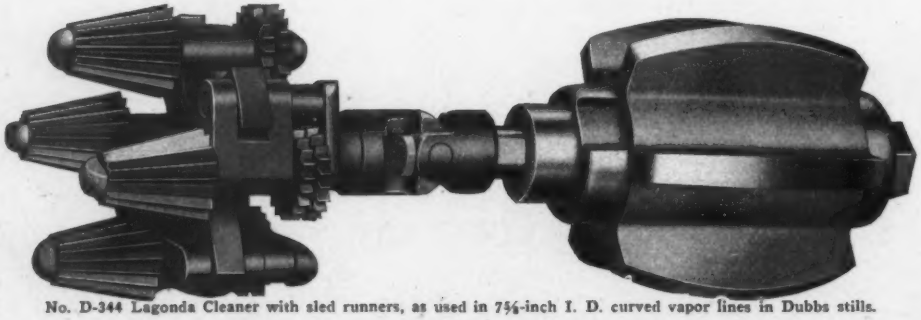
The oil refineries find it necessary to clean various tubes and pipes, ranging in size from quite small to large diameters. Lagonda Cleaners are being furnished for this work in sizes and with motor and cutting head equipment exactly fitted to the work in hand. Lagonda Cleaners can be furnished or will be developed for any particular service.

Experience in oil refinery work has fitted our representatives to advise authentically as to the best cleaner for any particular service.

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO.
FUEL SAVING SPECIALISTS
NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND CINCINNATI, DETROIT, SYRACUSE, BALTIMORE
ST. LOUIS, KANSAS CITY, DENVER, DALLAS, ATLANTA, SAN FRANCISCO, MONTREAL, LONDON.

Makers of Lagonda Tube Cleaners for all types of boilers, Condenser Tube Cleaners, Boiler Tube Cleaner, Cap and Header Reseating Machine, Cleaner, Feeding Device for Curved Tube Boilers.

X-1403



No. D-344 Lagonda Cleaner with sled runners, as used in 7⅝-inch I. D. curved vapor lines in Dubbs stills.

Lagonda Cleaners

Tell them where you saw the ad.

Guardians of the Pipe Lines

Why Williams Valves Stand First

Where the smoke of thousands of chimneys tell of the restless activity of the world's mightiest industries you will find Williams valves guarding the pipe lines.

In the great steel mills of the Pittsburgh and Bethlehem districts in the refineries—shipyards—railroads and central station plants valves are installed on merit alone. Here they know metals; here they know workmanship; here, where service is most severe, tests most scientific and records most accurate, Williams valves are installed BECAUSE THEY MAKE GOOD IN EVERY WAY.

Known generally as the extra heavy line of valves, men of experience also know that this extra material is so perfectly distributed and of such superior quality that Williams Valves are really the most economical in the long run.

Until you use Williams Valves you cannot appreciate how much they will contribute to the prosperous and economical operation of your plant.

They are made in many types and sizes to suit most every industrial or power requirement.

Our dealer in your territory can supply your needs promptly

The D. T. Williams Valve Company

Cincinnati, Ohio.

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Regrinding Valves, No. 107 is one of the Williams Superior types that has built the Williams reputation for long, dependable service throughout industry. Discs and seats extra heavy, special metal, machined for a **tight bearing.** Seat may be reground with a little oil and emery; a few moments' work, and the valve is like new. No extra discs ever required, making an important saving. Stem, extra heavy and strong, of best bronze. Will not bend or break. All threads engaged when valve is closed, preventing stripping or unequal wear. **Exclusive** feature with the **Williams.** May be repacked under pressure with absolute safety. Sustains 200 lbs. pressure easily.

Install ONE and let it prove its value.

The same duty in almost half the length

The G-R Twin Heat Exchanger

is only a little more than half the length of a single unit designed for the same duty.

This means a more compact apparatus, with less expansion and resulting strains on piping connections, smaller space required for tube bundle removal, and high salvage value because of ease of disconnecting, transporting and re-erecting at new locations to meet changing conditions.

And these are only part of the advantages of the G-R Twin Heat Exchanger. This unit, used for interchanging heat between crude oil feed stock and still bottoms, cold water and hot oil, feed stock and hot still vapors, etc., will speed up your refining operations and reduce your refining costs.

Send the Coupon for Complete Information

THE GRISCOM-RUSSELL COMPANY

Dept. K, 285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
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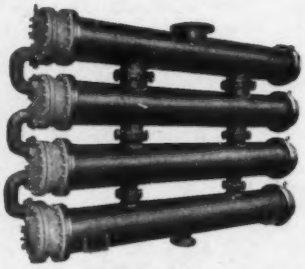
Griscom-Russell

Heat Transfer Apparatus

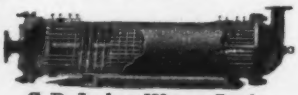
Note these other G-R units for lower refining costs



G-R Sectional Condenser
for condensing hydrocarbon vapors and other vapors. Can be used either as a standard or reflux condenser. The sectional arrangement permits using as a condenser and heat exchanger in one set or to obtain a different cut from each section.

Mineral Seal Oil Heat Exchangers
A compact, twin exchanger with strict counter-current flow to promote maximum rate of heat interchange.

G-R Vaneflo Gas Cooler
for cooling casinghead or natural gas. Can be used as inter-, after-, or precooler in absorption and compression type natural gasoline plants. Has low pressure loss and exceptional efficiency.



G-R Jacket Water Cooler
Uses any source of raw water to cool the jacket water from oil and gas engines and compressors. The famous Multiwhirl Cooler—over 2000 in operation in every liquid cooling service.

G-R Gasoline Condenser
For condensing natural gasoline vapors in casinghead gasoline plants. Can also be used as a knockout box or fractionating tower control section with particularly close control of the end points.

The Griscom-Russell Company.
Dept. K, 285 Madison Ave., New York.

Please send information on

- ☐ Twin Heat Exchanger
- ☐ Sectional Condenser
- ☐ Mineral Seal Oil Heat Exchanger
- ☐ Vaneflo Gas Cooler
- ☐ Jacket Water Cooler
- ☐ Gasoline Condenser

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R3-26

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

FINISHED GASOLINE

A cracking process which relies on the balance of the refinery to finish its product places an unnecessary burden on that refinery.

The Jenkins Cracking Process produces High Quality gasoline — finished except for the doctor treatment.

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EAST CHICAGO, INDIANA

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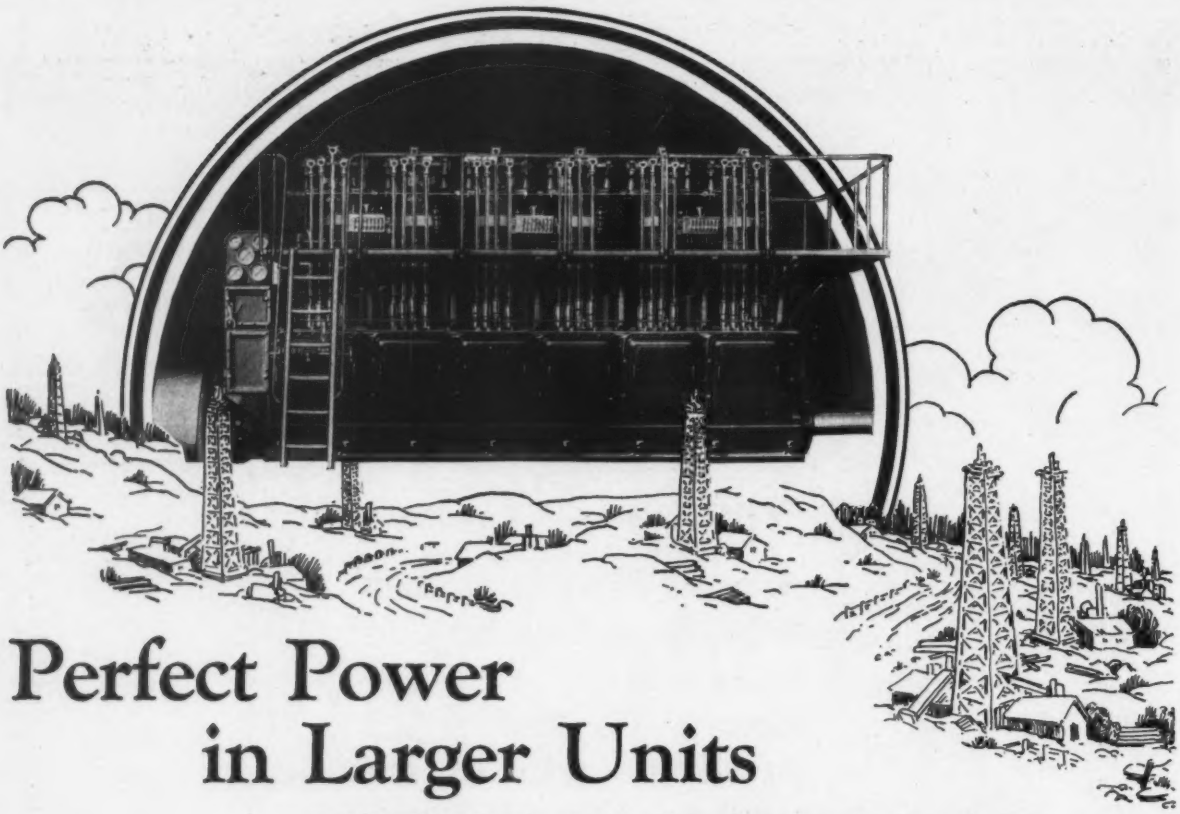


Perfect Power in Larger Units

BESSEMER Diesels have been developed and perfected to supply the Oil Industry with a power source of typical Bessemer efficiency and durability in units of larger horsepower.

For pipe line pumping stations, as the main power plant in refineries, for boats and tankers, and for use wherever a dependable heavy duty power source of large horsepower is needed, a Bessemer Diesel is the most reliable, economical and efficient power unit that can be installed.

Bessemer Diesels, like all other Bessemers, are built overstrength in every part to outwork and outlast any other similar equipment. They are unusually quiet, have a lower fuel consumption per horsepower and will work continuously for a lifetime. Bessemer Diesel efficiency is proved by the operating records of scores of installations.

Before you install a heavy duty power plant investigate the perfected Bessemer Diesel, the engine that has proved itself the best in Oil Industry, Marine and Identical service.

THE BESSEMER GAS ENGINE COMPANY
18 York Street ∴ ∴ Grove City, Pa.

BESSEMER

BESSEMER OIL FIELD ENGINES – COMPRESSORS VACUUM PUMPS – ROLLER PUMPING POWERS

Tell them where you saw the ad.

TAG

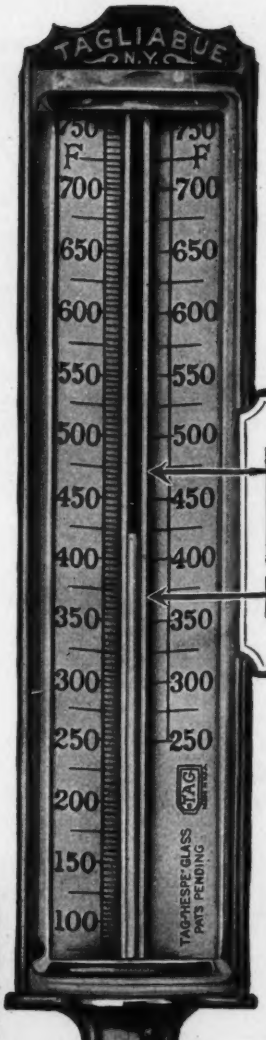
Recording and Dial-Indicating Thermometers
Recording Pressure Gages
Oil-Testing Instruments
Thermometers, Hydrometers, etc., etc.
Automatic Controllers for Temperature, Time, Pressure, Humidity, etc.

Only TAG can supply the genuine TAG-HESPE FEATURE

incorporated in an Industrial Thermometer. Some manufacturers' salesmen claim that TAG-Hespe Glass is not a recent development. For your information, patents for TAG-Hespe Glass were granted to Alfred T. Hespe on Nov. 17, 1925, bearing Nos. 1561925 and 1561926. We have the exclusive North American license under these patents for thermometers for any industrial use or purpose.

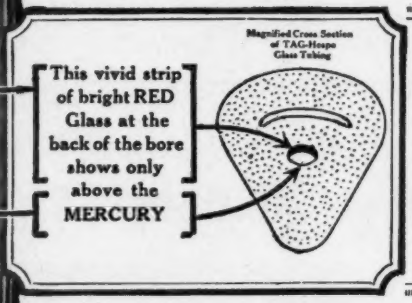
BULLETIN B-928

listing TAG Industrial Thermometers *carried in stock* ready for shipment, is itself ready for mailing. Write for it.

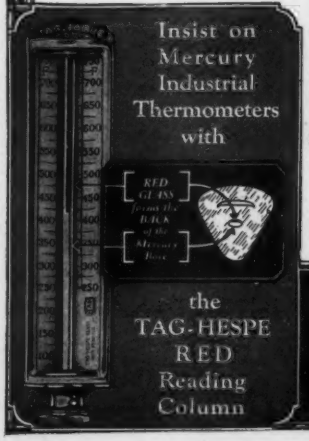


This Readable THERMOMETER

has won all industry—a notable feat: When three short years ago TAG-Hespe Glass came out, it had to struggle against being confused with the obsolete "ruby-back" glass. That old device was impractical, because the red showed at both sides of the mercury column. In TAG-Hespe Glass the bright color shows *only above* the mercury. Once this was understood, industry after industry adopted it. Then began a second struggle—against imitations. These, however, proved so inferior that the fight was soon over: all you had to do was to compare them with the genuine. TAG-Hespe Glass has won out—because, being good and practical, it has *spread the use of thermometers* on thousands of applications where the difficulty (or impossibility) of reading ordinary thermometers had previously caused huge losses. *Full details in Bulletin B-911*


This vivid strip of bright RED Glass at the back of the bore shows only above the MERCURY
Magnified Cross Section of TAG-Hespe Glass Tubing

TAG-Hespe Glass is similar to ordinary improved lens-front thermometer glass tubing, except that in TAG-Hespe Glass the *back* of the fine *bore* (up and down which the mercury travels) is made of bright red glass. Not a drop of red spirit is used in these *Mercury* Thermometers.



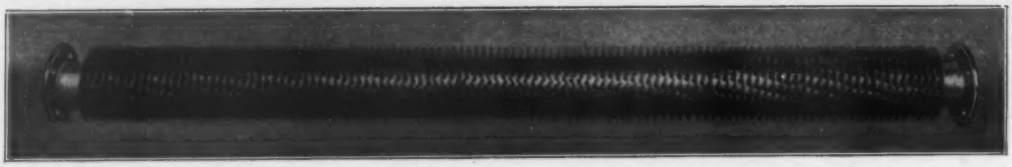
Insist on Mercury Industrial Thermometers with the TAG-HESPE RED Reading Column

C. J. TAGLIABUE MFG. CO.

18 to 88 Thirty Third St., Brooklyn, N.Y.

OFFICES AND STOCKS IN PRINCIPAL CITIES

Tell them where you saw the ad.



Introducing

—the—

SCHUTTE KOERTING RADIAFIN TUBES

for heating or cooling air or gases

THE FINS INSURE MAXIMUM HEAT TRANSFER.

Built in 1″, 2″ and 3″ sizes—all lengths—with or without headers.

Address Heat Transfer Dept. for complete information.

SCHUTTE & KOERTING CO., 1253 N. 12th Street PHILADELPHIA, PA.

In New Jersey, California Texas and Minnesota—

and all the way between, Walsh Refractories are lowering operating costs of furnaces and boilers. Such a country-wide reputation must have been earned by proved results.

Without obligation, interested executives may obtain this helpful book free for the asking. 32 illustrated pages of useful concise information.

WALSH REFRACTORIES

WALSH FIRE CLAY PRODUCTS COMPANY

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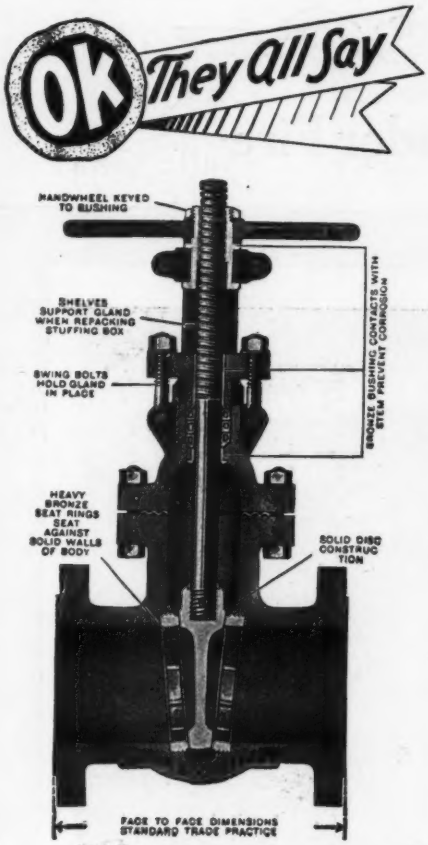
Ok They All Say
HANDWHEEL KEYED TO BUSHING
SHELVES SUPPORT GLAND WHEN REPACKING STUFFING BOX
SWING BOLTS HOLD GLAND IN PLACE
BRONZE BUSHING CONTACTS WITH STEM PREVENT CORROSION
HEAVY BRONZE SEAT RINGS SEAT AGAINST SOLID WALLS OF BODY
SOLID DISC CONSTRUCTION
FACE TO FACE DIMENSIONS STANDARD TRADE PRACTICE

The New Designs of
LUNKENHEIMER
IRON BODY BRONZE MOUNTED
GATE VALVES

have received the stamp of highest approval wherever they have been installed. And the list of users includes many discriminating operating executives whose extensive experience makes them competent judges of what a really good gate valve should be. The new line of Lunkenheimer Gate Valves inherits the quality characteristic of all products manufactured by The Lunkenheimer Company. They embody the best engineering thought, highest grade materials, the most modern foundry and plant facilities, and skilled workmanship by craftsmen who are specialists in the manufacture of quality valves.

Outstanding Features
which will appeal to all users of Gate Valves

Face to Face Dimensions—Standard Trade Practice.

Machined Guides—Long ribs in body as well as the grooves in disc are carefully machined, and engage with minimum clearance. The disc rides straight and true to its seat without detrimental chattering or marring of seat faces.

Solid Bronze Disc in sizes up to 6-inch; iron disc with bronze faces in 7-inch and larger sizes.

Bronze Stem Bushings. Prevention of corrosion with consequent ease of operation is assured by renewable bronze bushings provided at all bearing points on stem, eliminating contact with iron parts of valve.

Heavy Bronze Seat Rings. Rings seat against solid walls of valve body—do not depend on a small flange on outer edge of ring to effect a joint with body.

Swing Bolts hold gland in place; entire removal of nuts unnecessary to raise gland.

Two Shelves cast within yoke arms support gland when repacking stuffing box.

Renewability. All parts are renewable, including the seats and disc, making the valve as a whole practically indestructible.

The maximum working steam pressure and the water pressure ratings are as follows:

Pattern	Steam (450° F.) All sizes	Liquid (100° F.) 12-inch and smaller
Standard	125-lb. W. S. P.	175-lb. W. P.
Extra Heavy	250-lb. W. S. P.	400-lb. W. P.

All Iron Gate Valves **for handling solutions which attack bronze but not iron, and** ***Quick Operating Gate Valves with lever,*** **are also procurable.**

Lunkenheimer Distributors, located in all industrial centers, carry large stocks, and render prompt service. Call on them for your requirements.

Complete information is contained in Gate Valve Book F. 511 JK a copy of which can be had upon request, without any obligation on your part.
JUST FILL IN AND MAIL THE COUPON.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO BOSTON LONDON
EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

THE LUNKENHEIMER CO. P. O. Box 676, Cincinnati, Ohio
Gentlemen:—Please send me, without obligation, a copy of your Gate Valve Book No 511.
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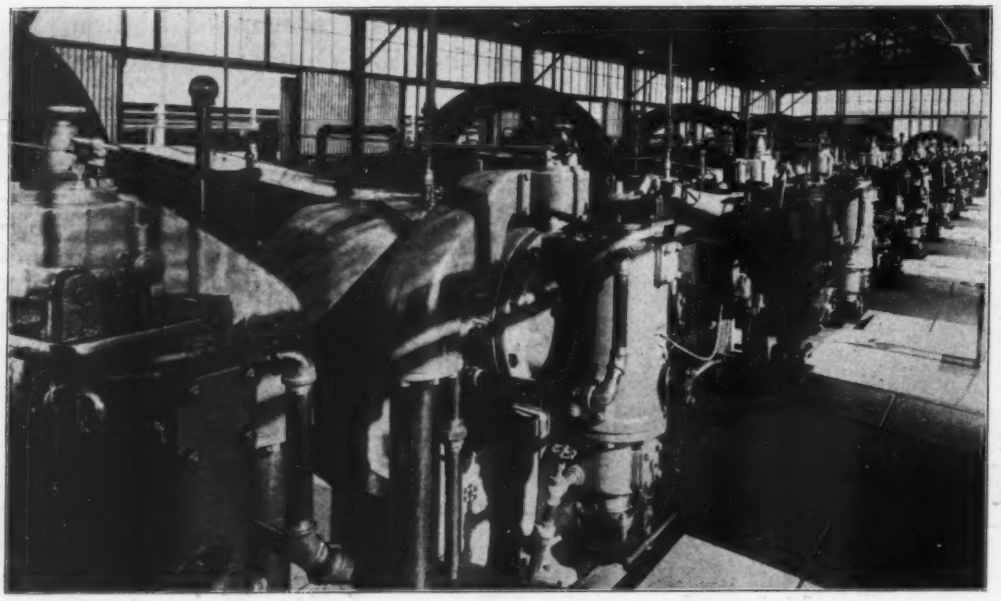
Firm .....
Address .....

6-42-90

How Does He Act Under Fire



Whether it's a hunting dog, a running horse, a straight eight, or the man who sits across the desk from us, we are never quite certain about him until we see how he acts under fire. Can we really depend on him when the test comes?

It is the same with manufacturing organizations. They can all make beautiful promises, well painted machinery and confidence inspiring guarantees. But there always comes a testing time for all of them and it's the way they measure up after the last payment has been made that forever wins men's confidence.

The Sinclair Oil & Gas Company have completed another installation of two Cooper Type-80 gas engines, known as Plant No. 6, near Covington, Oklahoma.

Cooper gas engines are built in standard sizes from 80 to 1500 B. H. P. for every power purpose.

The C. & G. Cooper Company

Mt. Vernon, Ohio

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The REFINER and NATURAL GASOLINE MANUFACTURER

EDITED MONTHLY AT TULSA, OKLAHOMA

GRADY TRIPLETT, *Editor*

Published by

GULF PUBLISHING COMPANY
HOUSTON, TEXAS

R. L. DUDLEY, *President* A. L. BURNS, *Gen'l Mgr.*

Vol. 5 MARCH Number 3

For men engaged in the operating branch of the refining and natural gasoline business

Price.....$1 per year

Advertising rates upon application to nearest office

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Gulf Publishing Co., 1925

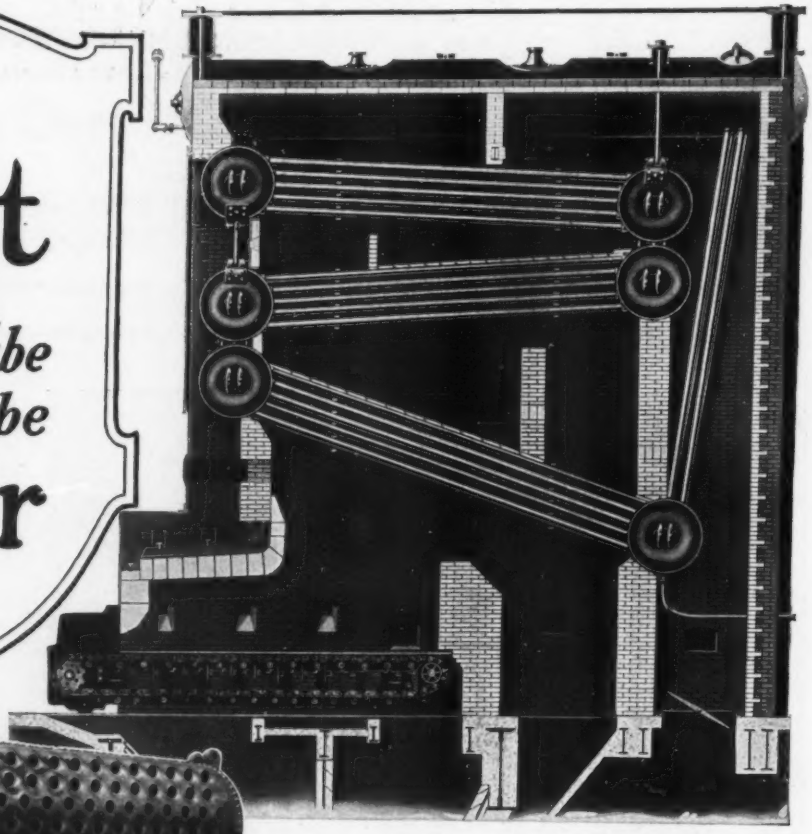
Western Petroleum Refiners' Association

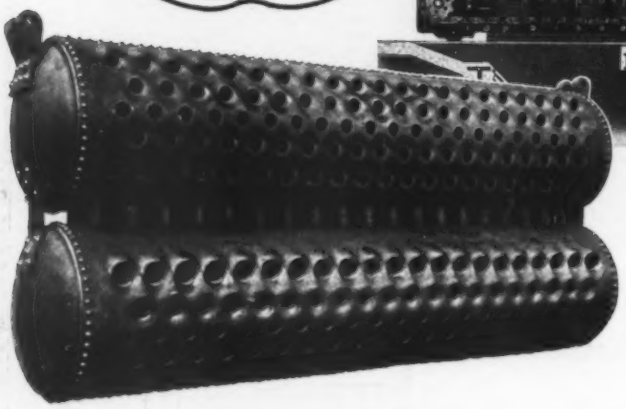
1926 Annual Convention

Fort Worth, Texas
March 2, 3 and 4, 1926
Texas Hotel

Officers of the Western Petroleum Refiners Association in charge of Ft. Worth Meeting

The Vogt Straight Tube Water Tube Boiler





Twin Cylindrical Headers

THE Vogt Straight Tube Water Tube Boiler is built with heating surface from 2500 to 10,000 square feet. It is for those who prefer a straight tube boiler. The A. S. M. E. boiler code is strictly complied with, in addition to the following correct principles of design.

High velocity, unrestricted and positive water circulation.
Flexibility of operation with high efficiency.
Relief of expansion and contraction stresses.
Ease of inspection, cleaning and repair.

Write today for Information

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KY.

New York Chicago Philadelphia Dallas

Manufacturers of: WATER TUBE AND HORIZONTAL RETURN TUBULAR BOILERS, DROP FORGED STEEL VALVES AND FITTINGS, ICE MAKING AND REFRIGERATING MACHINERY AND OIL REFINERY EQUIPMENT.

Western Petroleum Refiners' Association 1926 Annual Convention

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Roy B. Jones.....*Vice-President*
Geo. D. Locke.....*Vice-President*
Howard Bennette.....*Managing Director*
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Fayette B. Dow.....*Counsel*
Washington, D. C.

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FIRST DAY

Tuesday, March 2, 1926

* * *

9:30 o'Clock A.M. Sharp

REGISTRATION

Lobby and 14th Floor
The Texas Hotel
Ft. Worth, Texas

* * *

10:00 o'Clock A.M. Sharp

TRAFFIC MANAGERS MEETING

Cactus Room, 14th Floor

R. R. Irwin, Vice-President White Eagle Oil & Refining Co., Presiding.

Docket 17000 and the Rate and Transportation Situation
Fayette B. Dow, Washington Counsel

Traffic and Its Place in the Industry
H. C. Mulroy, Vice-President, Marland Refining Co.

Miscellaneous Subjects

* * *

1:30 o'Clock P.M. Sharp

GENERAL MEETING

President F. A. Pielsticker, Presiding, Crystal Ball Room, 14th Floor

President's Annual Address
Washington Counsel's Address

* * *

CREDIT AND SALES MANAGERS MEETING

Crystal Ball Room, 14th Floor

Geo. D. Locke, Vice-President, Barnsdall Refining Company, Presiding

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"WHOLESALE SELLING OF OILS"

R. R. Irwin, Vice-President, White Eagle Oil & Refining Company

DISCUSSION

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"CREDITS"

A. B. Eisenhower, Vice-President, Commerce Trust Company, Kansas City, Mo.

DISCUSSION

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BARBECUE AND ENTERTAINMENT

For the Men
(Details to be announced)

SECOND DAY

Wednesday, March 3, 1926

9:30 o'Clock A.M. Sharp

TECHNICAL MEETING

Crystal Ball Room, 14th Floor

C. L. Henderson, Vice-President, Vickers Petroleum Co., Presiding.

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"DECREASING REFINERY EVAPORATION LOSSES OF GASOLINE"

Ludwig Schmidt, Associate Petroleum Engineer, Bureau of Mines.

DISCUSSION

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"THE MIND AS A FACTOR IN INDUSTRIAL ACCIDENTS"

Isaiah Hale, Safety Supervisor, Atchison, Topeka and Santa Fe Railway Company

DISCUSSION

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"SPECIFICATIONS OF PETROLEUM PRODUCTS"

Dr. A. P. Bjerregaard, Petroleum Technologist, Empire Refineries, Inc.

DISCUSSION

BUFFET LUNCHEON

14th Floor

* * *

"CONTRIBUTING FACTORS TO CORROSION WITH SPECIAL REFERENCE TO SULPHUR."

Dr. C. K. Francis, Petroleum Technologist

DISCUSSION

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"WHAT DOMESTIC AND INDUSTRIAL OIL BURNING MEAN TO THE REFINER"

Edward P. Bailey, Treasurer, National Airoil Burner Co., Formerly President American Oil Burner Assn.

DISCUSSION

* * *

"WHAT DOES INSULATION MEAN TO THE REFINER?"

L. E. Cover, Engineer with Armstrong Cork & Insulation Company

DISCUSSION

EVENING

7:00 o'Clock P. M. Sharp

ANNUAL BANQUET

Main Dining Room, Lobby Floor

PROGRAM

Toastmaster—R. L. Welch, Secretary and Counsel, American Petroleum Institute.

"The Price We Pay"—Sidney Samuels, Attorney at Law.

"Past and Present"—D. W. Moffitt, Vice-President, Mid-Continent Petroleum Corporation.

THIRD DAY

Thursday, March 4, 1926

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9:00 o'Clock A. M. Sharp

BREAKFAST

Main Dining Room, Lobby Floor

President, F. A. Pielsticker, Presiding.

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"TAXES AS A COST OF DOING BUSINESS"

Harry H. Smith, Secretary. Mid-Continent Oil & Gas Assn.

DISCUSSION

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EXECUTIVE SESSION

MEMBERS ONLY

Election of Officers and Directors
New Business

MEETING OF BOARD OF DIRECTORS

The newly elected officers and directors will meet at a Luncheon, in the Longhorn Room No. 1, Mezzanine Floor, immediately following the adjournment of the Executive Session, for the purpose of selecting the Executive Committee and electing a Managing Director and Treasurer for the ensuing year and the transaction of such other business as may be presented for consideration.

Tests Made to Determine Specifications of Various Products

By A. P. Bjerregaard
Chief Technologist, Empire Refineries, Inc.

Before convention of the Western Petroleum Refiners' Association at Fort Worth, Texas

THIS paper deals with some tests of petroleum oils in relation to the drawing up of specifications for certain petroleum products. The subject is so large that it has been necessary to select a few of the more common tests used in differentiating gasolines, lubricating oils and fuel oils, and these only will be discussed in this paper.

The methods of carrying out these tests will not be considered except incidentally. These testing methods have been well described so often that nothing new could be added in this direction. But some of the underlying philosophy of these tests will be considered here with the view of making clearer to our minds the principles on which these tests are based and their application in the laying down of specifications.

The subject will be taken up under the heads of:

Gravity
Distillation
Color
Viscosity
Flash and Fire.

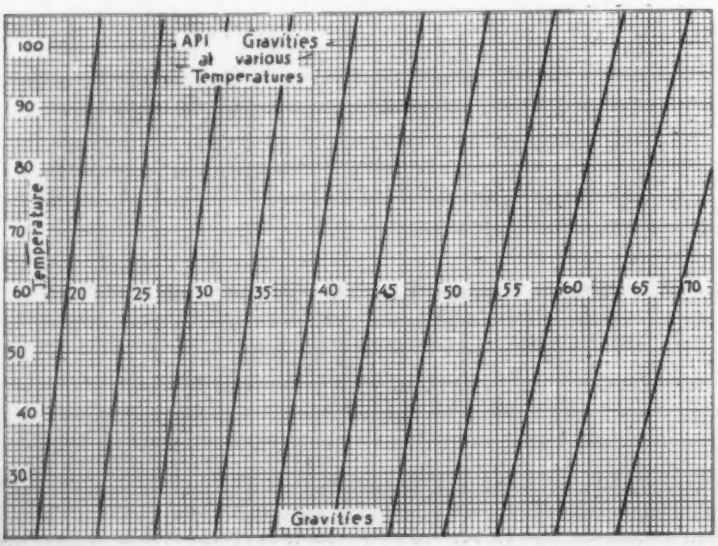
Gravity

All petroleum oils are regularly subjected to a test for gravity. The natural basis for the expression of this property would be the specific gravity, which shows the relation of the weight of a given volume of the oil to the weight of the same volume of pure distilled water at a certain temperature. However, in the American oil industry the use of specific gravity figures direct has not come into vogue, but instead the so-called Baume scale of degrees, or more recently the A. P. I. scale of degrees is used. This is related to specific gravity by the following mathematical expression:

$$\text{A. P. I. degrees} = \frac{141.5}{\text{Sp. Gr. } 60/60^\circ \text{ F.}} - 131.5$$

Petroleum oils of all kinds expand considerably with increase of temperature. Therefore, the gravity of the oil changes with temperature, and consequently it has been necessary to fix on a standard temperature at which the gravity shall be determined, namely 60 degrees F. in America.

The accompanying diagram shows in a graphic manner the changes that the gravity of petroleum oils undergo with changes of temperature. Only a few sample instances are presented, simply to illustrate the subject. Oils of every 5 degrees A. P. I. difference of gravity are shown ranging from 20 degrees to 70 degrees A. P. I. and over a temperature range of 30 degrees to 100 degrees F. In this diagram the A. P. I. degrees are taken horizontally; the lowest A. P. I. degrees of heaviest gravities are to the left and the higher degrees or lighter gravities are to the right. Temperatures are taken vertically.



Lines have been drawn through the fixed points of observed gravities at the observed temperatures. It will be noted that these lines all slope towards the right upwardly. That is to say, the gravities become lighter as the temperatures become higher. One concrete illustration will suffice to make clear the genreal trend of facts. Take an oil of 35 degrees A. P. I. at 60 degrees F. Then this oil will have A. P. I. gravity 36 at 74 degrees F., 38 at 101 degrees F., or reading downwards, 34 degrees A. P. I. at 46 degrees F., 33 at 31½ degrees F.

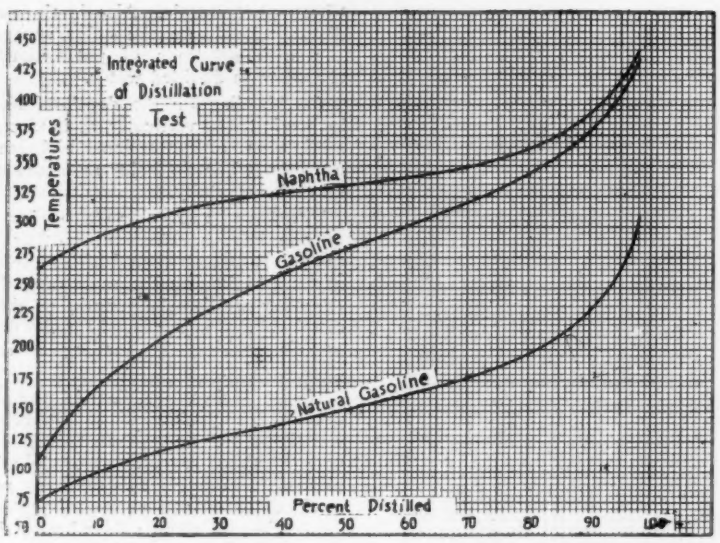
It will also be noted that the slope of these diagrammatic lines becomes greater as the A. P. I. gravities become higher. This signifies that the rate of change of gravity becomes greater the lighter the gravity of the oil.

Furthermore, fortunately, all petroleum oils, from whatever source, if of the same gravity at the standard temperature, have practically the same rate of expansion for temperature, so that this diagram and the corresponding tables of corrections are true for all petroleum oils, whether paraffine base, asphalt base, or mixed base, and it is also true of all fractions no matter what their boiling points may be, nor whether wide or narrow cuts. Consequently one set of correction tables is equally available for petroleum oils from all sources, greatly simplifying the writing and interpretation of specifications.

Gravity signifies very little concerning most petroleum oils regarding their actual use. Its principal purpose in specifications, if used at all, is to limit the oil specified to a given crude source, since oils equivalent in other respects, but derived from various crudes will differ in gravity. Pure paraffine base oils have lighter gravities than pure asphalt base oils, and mixed base oils are intermediate in gravity, other essential properties being equal.

Distillation Test

The distillation range is one of the



most important items for which specifications have to be set in the case of light oils such as gasolines and naphthas. It is therefore vital that the results of the distillation test should be properly interpreted in order that its significance may be properly set forth in terms of specification statement.

In order to get a mental picture of the relationship between the different parts of the distillation fractions a diagram is often drawn, namely the well-known distillation curve.

In the accompanying diagram three samples of typical distillation curves are drawn by this usual method of representation. The three oils thus used are a natural gasoline, a refinery gasoline and a naphtha. This sort of a diagram may be designated an integration curve of the distillation test, since it indicates the position of the sum of all the distillates progressively at each successive temperature reading.

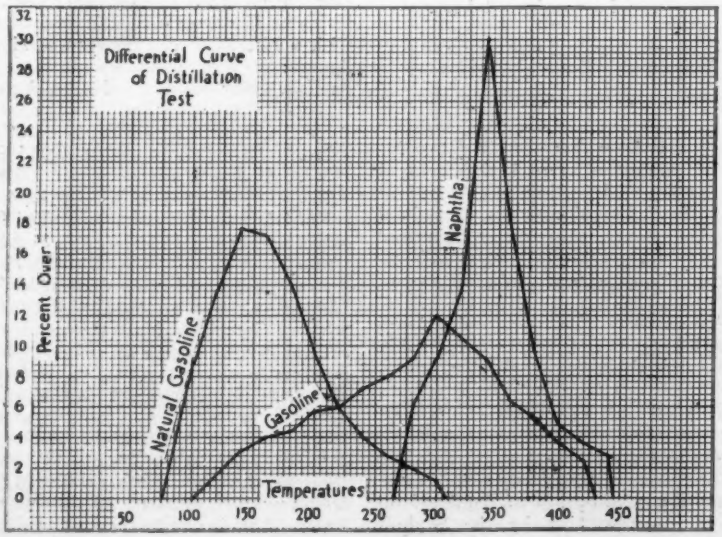
Sometimes a better mental picture of the relationships of light oils by their distillation data may be obtained by means of another sort of diagram which may be called the differential curve of the distillation test.

A diagram illustrating this kind of a curve is here presented which shows the same three oils as the first diagram does. In order to make this kind of a diagram the amount distilling over between each successive equal temperature interval during the distillation are recorded and made use of.

For comparison these two sorts of distillation data for these three oils are given in figures in tabular form.

	Naphtha	Gasoline	Natural Gasoline
I. P.	264	110	76
10%	290	168	100
20	308	206	114
30	320	236	128
40	328	260	138
50	334	284	150
60	340	302	162
70	350	320	176
80	366	344	196
90	392	378	232
95	418	405	262
E. P.	445	436	305

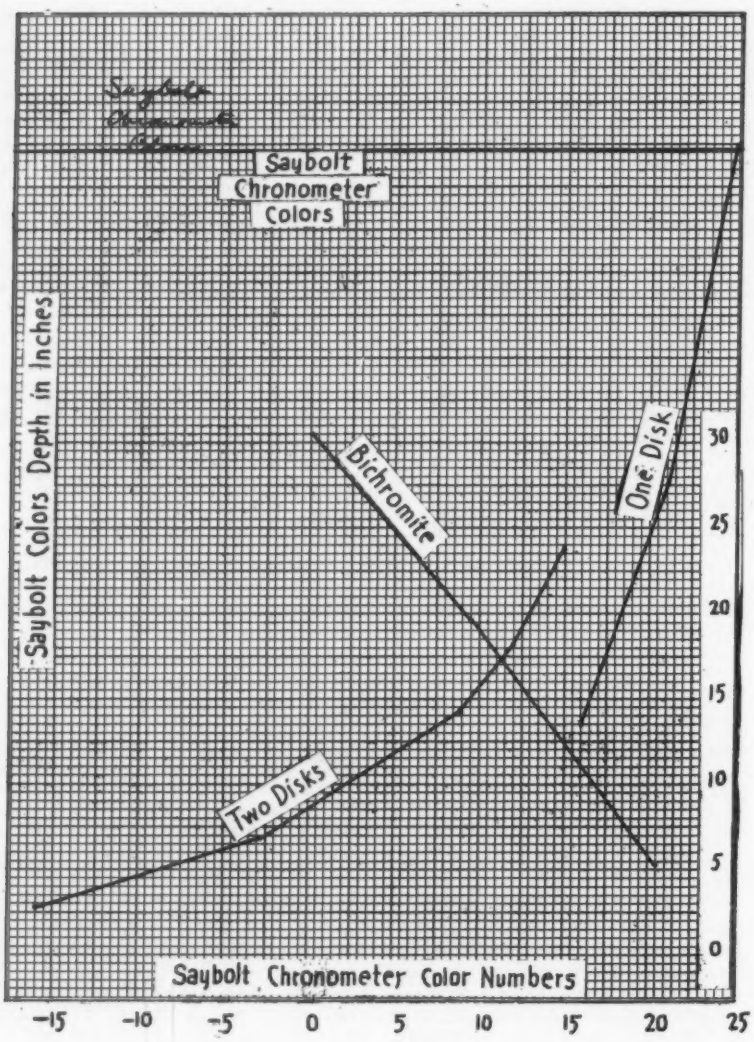
Naphtha		Gasoline		Natural Gasoline	
Up to 280	6%				
280-300	9	Up to 120	1½%	Up to 80	1½%
300-320	14	120-140	3	80-100	8½
320-340	30	140-160	4	100-120	13½
340-360	18	160-180	4½	120-140	17½
360-380	9½	180-200	5½	140-160	17
380-400	5½	200-220	6	160-180	14
400-420	3½	220-240	7	180-200	9½
Above 420	3	240-260	8	200-220	6
		260-280	9	220-240	4
		280-300	12	240-260	3
		300-320	10½	260-280	2
		320-340	9	280-300	1½
		340-360	6½	Above 300	½
		360-380	5		
		380-400	3½		
		400-420	2½		
		Above 420	1		



The advantages of the differential form of representation lies in the ease with which a wide range product is distinguished from a narrow range one, and more especially in the way it indicates clearly the main portion of the distillate by the location of the peak of the curve.

For illustration, and referring to the diagram of the differential curves, it will be seen that the natural gasoline curve scarcely overlaps the naphtha curve at all; they are entirely separate and the two oils have practically no fractions in common. On the other hand the refinery gasoline shows a wide range; it has some ingredients in common with the natural gasoline and much more in common with the naphtha. Also it will be seen that the bulk of this particular refinery gasoline is really a naphtha, as shown by the location of the peak of the curve.

This differential curve is not used as much in the petroleum industry as it



ought to be, and its value as an aid to the correct understanding of the internal constitution of gasolines would become greatly appreciated if it were more used.

As is well known the government in making its specifications for gasolines, has practically designated a certain shaped curve of the integration type, by setting certain figures that the distillation test must meet throughout the distillation range. Whatever may be thought of the wisdom of the government's particular choice of curve, there can be no doubt that whatever distillation figures are used in drawing up specifications for gasolines, their relationships on one or both these types of curves must be taken into consideration.

Color

Color has been a very important item in most specifications heretofore drawn up for petroleum products, but except in special instances color really has no particular signification as related to the use of petroleum oils.

Two systems of color statements are in use at present in the petroleum industry and since they both enter largely into questions of specification writing they will be considered here.

Saybolt Chromometer for Light Oils

The principle used in the determination of the color of light gravity and nearly colorless oils such as gasoline is different from that used in determining the color of more highly colored oils such as lubricating oils.

In the light colored oils, two fixed color standards, one exactly twice the density of the other, are used. Therefore, only one color tint is made use of, with which different thicknesses of oil are compared. The color scale, therefore, bears a proportionate relationship to the actual depth of color, or rather, an inverse relationship. The real basis underlying this scale is the color of an aqueous solution of potassium bichromate.

The accompanying diagram illustrates the relationship of depth of oil to color numeration by the Saybolt Chromometer scale. Also in the same diagram is shown the color comparison with solutions of potassium bichromate in distilled water.

In this diagram the depth of oil in inches is taken vertically, as is also the milligrams of potassium bichromate per liter, while the color numeration is taken horizontally.

The use of two color glasses instead of one has the effect of cutting the curve into two parts and lifting the one part up higher on the scale of inches. In other words, the length, or depth of oil column is increased for the darker oils, making the reading of their colors easier.

If the bichromate line in the diagram were prolonged downwards it would cut the zero percent of bichromate at about 25 color scale; in other words, 25 color is the same as pure distilled water, and colors of gasoline better than 25 mean colors better than the color of pure distilled water.

A. S. T. M. Color System

The colors of lubricating oils are taken in the opposite way, since a fixed depth of oil is compared with variable color standards. These color standards are of glass and are based on the Lovibond Color System.

As the color numbers of the lubricating oils become higher there is more red and more yellow in the make up of the color glasses, and in several of the darker glasses there is also a small amount of blue. The increments of color, however, art not uniform, either for the red or for the yellow, so that curves to represent their relationships show considerable irregularities.

In the diagram shown here, only the red and the yellow portions of the total color is plotted. The blue is in very small amount and the places where this color is used are only indicated by the word "blue."

Another way of showing the comparison of colors is to blend a light colored oil with a dark one; thus a series of blends of a No. 2 colored oil with a No. 8 colored oil showed these figures:

A. P. I. Color	No. 8 Color Oil
No. 2	0
No. 2½	1.4%
No. 3	3.1%
No. 3½	7.0%
No. 4	12.7%
No. 4½	19.4%
No. 5	31.3%
No. 6	46.4%
No. 7	70.0%
No. 8	100.0%

These data have been plotted in the accompanying diagram, where color numbers are taken vertically and per cent No. 8 colored oil horizontally. This curve shows a fairly uniform shape, and it also indicates that the increments of color density between color numbers are much greater in the higher color numbers than in the lower. This is due to the lack of sensi-

tiveness of the eye for small differences at the denser concentrations of color.

The one small irregularity in this curve corresponds to the very large irregularity in the color glass diagram previously discussed.

Diluting dark colored oils with a colorless naphtha gives a new series of colors differing markedly in depth of color from what would naturally be expected, being very much darker. Thus a series of standard colored oils were diluted on the 15/85% basis and the following colors were obtained:

Original A. P. I. Color Number	A. P. I. Color of the 15/85 Dilution Number
2	1⅛
2½	1¼
3	1½
3½	1⅝
4	1¾
4½	2¼
5	2½
6	3⅛
7	3½
8	4

The diluted colors, therefore, instead of being 15 per cent of the original color are in fact slightly darker than ½ of them. This fact has a very important bearing on that phase of specification of color of lubricating oils in which the oils are too dark for direct observation and the color of the diluted oil is specified.

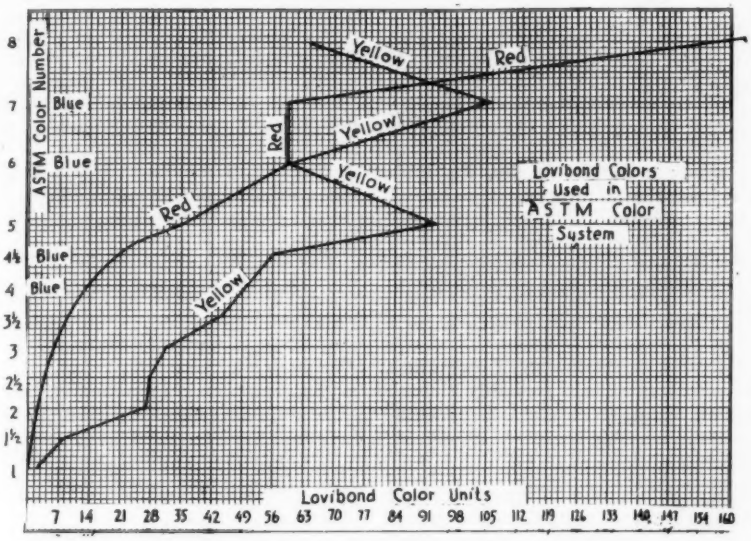
Remembrance of these facts relating to color determination and color nomenclature will help in writing and in interpreting the color items of petroleum specifications.

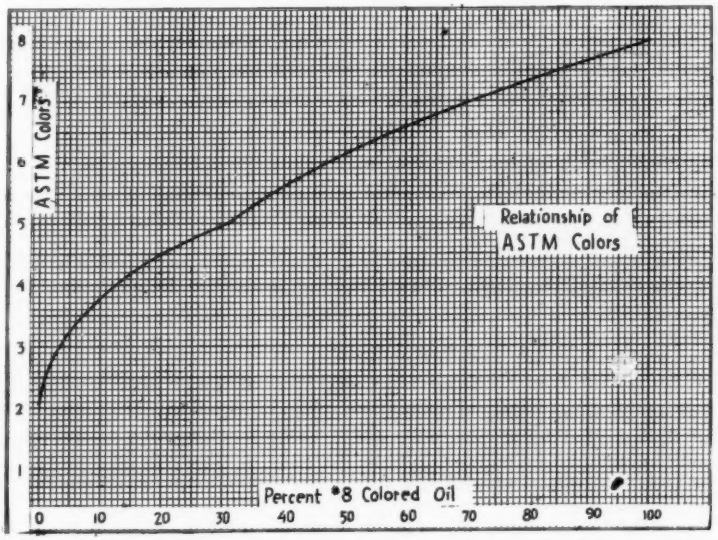
Viscosity

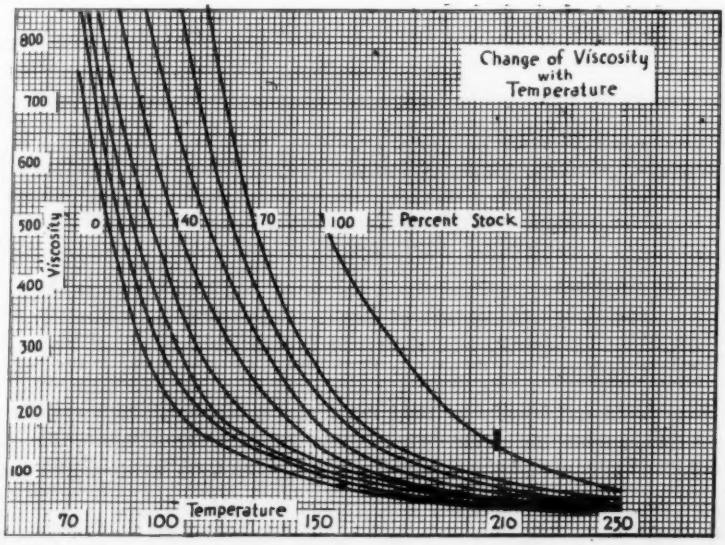
The most important item in the specifications usually set up for lubricating oils is the viscosity, because, for the class of mineral oils, viscosity has a relationship to the lubricating value. The higher the viscosity the heavier the loads per square inch of bearing surface the oil will support.

If an oil thinner in viscosity is used than the load requires, the oil will be forced out from between the bearing surfaces and metallic contact will ensue, leading to the destruction or injury of the bearing. However, the viscosities required are much less than those usually called for. One the other hand the higher the viscosity the more energy is absorbed in internal friction in the oil itself. Therefore, an important rule in lubrication engineering is "Use the lowest viscosity oil that will stay in the bearing, under all the conditions to which that bearing will be subjected." The use of too high a viscosity oil results in loss of power due to this internal friction, which loss may become considerable with very heavy bodied oils.

Viscosity is defined in oil technology as the time in seconds it takes for a standard amount of the oil in question







to flow through a certain standard sized hole, under standard conditions of head and temperature. In order to get these standards fixed a certain apparatus known as the Saybolt Universal Viscosimeter is used in this country for lubricating oils. Most foreign countries make use of other instruments, such as the Engler, the Redwood, or the Barbey.

Since all the other conditions are fixed in any one type of instrument, only one variable remains, namely, the temperature, and it is controllable in all these viscosity testing machines.

All oils become appreciably thinner in body, or in other words have lower viscosities the higher the temperature. At the temperature probably prevailing on the inner wall of the internal combustion engine most lubricating oils have about the same viscosity. This is illustrated by the accompanying diagram, which represents a series of blends of a Mid-Continent neutral oil with a Mid-Continent bright stock.

It will be noted particularly that the viscosities are all extremely high at 70 degrees F. and all are very low and practically identical at 250 degrees F. It will also be noted that at 100 degrees F., at which most commercial viscosities are taken, the slope of the curves are all quite steep. This signifies that small differences in the temperature of the oil and its surrounding apparatus when measuring the viscosity will have a large influence on the viscosity figure obtained. This source of error is very much smaller at 210 degrees F.

These facts must be borne in mind in designing specifications of lubricating oils in order to avoid errors.

Flash Point and Fire Point

The flash point is supposed to show the temperature at which the oil undergoing test will give off enough inflammable vapors to ignite momentarily, the fire becoming extinguished instantly for lack of fuel. The fire point is likewise supposed to show the temperature at which such large volumes of vapor are given off that they will continue to burn, once having been set on fire. As a safety factor, or as an indication of the inflammability, therefore, the flash and fire points are important items in specifications of various petroleum products.

This test, when the open cup method is used, is extraordinarily sensitive to the effect of surrounding conditions. This sensitiveness is due to the fact that what is really taking place is a race between the evolution of inflammable vapors and the removal of these same vapors by air currents and by diffusion. In order to have this race always under the same conditions, the air currents must be always the same, and the rate of heating must be always the same.

If the temperature is raised too fast the vapors generated will not have time to be removed and the flash indicated will be too low. If the air currents are too vigorous the vapors will be blown away and it will take longer for a sufficiently explosive blend of vapor and air to accumulate, and therefore the flash indicated will be too high. If the rate of heating is too slow the vapors will have more time to be removed by the air currents and so the flash will be too high.

The introduction of the iron plate under the Cleveland Open Cup several years ago was in reality an attempt to control the air currents arising from the heating flame, or other heating element, below, and it has been fairly successful in making the flash test more concordant.

The closed cups are not so sensitive because air currents have very much less access to the vapor chamber, and therefore the vapors are not readily blown away, with the consequence that the flash is always decidedly lower in a closed cup than in an open one. At the same time concordant results by various operators are more easily obtainable by the closed cup properly manipulated.

Small proportions of low flash oils in blends have quite a large effect on lowering the flash point on account of the differential evaporation of such more volatile oils, but if the proportion is too small, or the volatility is so great that all of it is removed before a flash is reached, then the low flash oil will have no effect on the flash point of the higher flash oil of the blend. So here also there is a race between the removal of the low flash constituent and the accumulation of sufficient vapor to lead to a flash.

It will be seen by these facts that the flash point figure of an oil is not necessarily that at which the oil will flash in use. Indeed the conditions in use are practically always so very different from the conditions obtaining during the test that no value can be placed on the flash point figure itself as an absolute factor of safety, or of inflammability. Nevertheless, bearing in mind the facts concerning the variability under variable conditions, the relative flash points of two or more oils, give a good indication of the relative safety or relative inflammability under the conditions of use.

Here as in all other cases it must be remembered that the figures set down have no significance in themselves and by themselves, but they must be properly interpreted in relation to the characteristics of the oil in the particular use it is to fill.

All this discussion on flash point is

(Continued on page 66)

NATURAL GASOLINE CONVENTION MAY 5 AND 6

Tulsa, Oklahoma.—May 5 and 6 are the dates set for the annual spring convention of the Association of Natural Gasoline Manufacturers. Sessions will be in the Mayo Hotel at Tulsa.

In the past spring meetings of the Association have been held in April. Due to that month having so many other conventions for Tulsa it was deemed wise to hold the convention of this year in May.

The program committee has been selected as follows: Lloyd F. Bayer, vice-president Tidal Refining Company, chairman; G. G. Oberfell, Phillips Petroleum Company, and A. M. Ballard, Sun Company.

This committee is bent on making the May meeting one of intense interest to the executive and the operator of the natural gasoline industry. Details have not yet been worked out but it is certain that some of the sessions will be given over to methods and practices of plant operation.

Decreasing Refinery Evaporation Losses of Gasoline*

By Ludwig Schmidt

Associate Petroleum Engineer United States Bureau of Mines

DURING the last two years much improvement has been made in refinery equipment and in methods of handling gaosline, so that today losses from the evaporation of gasoline in the average Mid-Continent refinery are probably only one half as great as in 1923 and 1924.

During the early spring and summer months of these years the writer conducted a series of tests in several refineries and at that time estimated the average evaporation losses of gasoline, in its various stages of handling, to be as follows:

Run down tanks	1.8%
Treating	0.5%
Filling tank car	0.5%
Storage	2.5%
Miscellaneous handling	1.0%
Total	6.3%

The one per cent "miscellaneous handling" loss is a composite estimate based on the assumption that gasoline is handled at least three times after leaving run down tank and includes proportionate blending losses as taken from plant records. The storage loss of 2.5 per cent is based upon the assumption that on the average gasoline is held three months before shipping.

At the time these tests were made, refineries were operating at about 80 per cent of their capacity. If the refineries had been operating at full capacity, the percentage loss would have been lower, because the actual evaporating surface per barrel of gasoline would have been less. On the other hand, if the refineries had been operating at less than 80 per cent, the percentage of evaporation loss would have been greater.

In Mid-Continent plants (exclusive of cracking units) the average yield of gasoline is probably about one-third of the total crude run. A six per cent loss of gasoline is therefore equal to a two per cent loss of the crude run. At the time of these tests, the average overall loss in these plants was probably between three and four per cent of the crude run. Thus the evaporation of gasoline may account for a considerable part of the overall refinery loss.

As already stated an average reduction of fifty per cent has been made and several refineries at the present time have succeeded in reducing their losses still further. There is of course an economic limit to the reduction of these losses, nevertheless improvement is still possible.

Reduction of Evaporation Losses

All methods for reducing evaporation may be divided into two general classes. "floating roofs" constitute one class while the other includes the systems which use vapor tight tanks.

Vapr tight tanks will eliminate practically all losses except those caused by "breathing" (due to variation in atmospheric conditions) diffusion and by the expulsion of gasoline laden vapors when a tank is filled.

The construction of a vapor tight tank is a comparatively simple matter. However, keeping the tank tight is another question and one which is not often given sufficient attention.

Tank Grades

Run down tanks and other refinery tanks are usually intended to be permanent and should, therefore, be placed on good foundations or "grades." There are two principal reasons for this: first, if the grade is not level when the tank is erected the rivet holes in the tank plates will not line up properly, resulting in unsatisfactory riveting. Also, the tank will be out of round making more difficult the connection of the roof plates with the top angle iron.

The second important feature is that some grades do not settle evenly. The grade will tend to settle after the tank is placed and if it settles unevenly stresses and strains will develop in the tank. These will distort the tank and leaks will develop along the seams and at the top angle. Leaks below the oil level are easily seen and repaired. Unfortunately, the larger leaks are usually around the top angle and in the roof seams. These are not easily located and therefore not repaired with the result the tank loses its effectiveness in reducing evaporation losses. Money spent wisely on tank grades will pay dividends, for well-built and well-drained grades will not only lengthen the time that the tanks will remain vapor tight, but will also tend to prevent corrosion of the tank bottoms.

Tank Fittings

Another method of increasing the life of a tank is to have all their hatches, valves, and other fittings located near the edge of the tank, so that the gager or operator will not have to stand or walk on the tank roof. Several of the bolted-tank manufacturing companies advocate this arrangement for field tanks, and it can easily be adopted by refiners for their run down tanks, as overhead walks are usually provided. The weight of a man walking over a tank roof several times a day will soon break caulked joints and cause pin holes to develop in roof seams.

Vapor tight tanks should be equipped with vacuum and pressure relief valves and vapor tight thief and gage hatches. If the tank is equipped with a swing line, it should enter the tank through a stuffing box. The writer has seen several tanks which were equipped with water sprays or other cooling devices, while the gage hatches consisted only of hinged lids. Even when new these lids could not be considered as vapor tight, and in use they were left open more often than not. Some instances were noted of the swing line entering the tank through the gage hatch, the free end of the swing line being wrapped around the guard rail or a rung of the ladder, thus holding the gage hatch partly open. Such practices allow air to circulate freely over the surface of the gasoline, thus increasing evaporation.

Evaporation from Run Down Tanks

There are several factors which influence the rate of evaporation from run down tanks.

First, is the temperature of the gasoline when it enters the tank. It is not unusual during the summer months to observe stream temperatures between 90 degrees F. and 100 degrees F. at the look box. Sometimes they exceed this. Since these high temperatures are not far below the initial boiling point of the gasoline the vapor pressure is high and the rate of evaporation is greatly accelerated.

Second, tail gases should be removed before the gasoline enters the tank. The vapor above the gasoline in the tank is often hotter than the vapor at the look box. If tail gases are allowed to flow through the run down lines with the gasoline, their temperature is increased. Therefore, they will carry away more gasoline vapor than if they were removed at the look box. If in addition these gases are allowed to bubble up through

CONSERVATION

In 1925 refineries of the Mid-Continent turned out 2,710,395,567 gallons of gasoline. Under conditions prevailing two years ago, 17,000,000 gallons of this total would have been lost through evaporation at the plants.

Ludwig Schmidt, who found evaporation losses at that time to be 6.3 per cent, believes better equipment and changed methods have cut this loss in half. Certainly it has been appreciably reduced.

That the percentage will be still further reduced is certain, for vapor saving equipment and knowledge are working to that end.

The Editor.

*Read before convention of the Western Petroleum Refiners' Association at Fort Worth, Texas, March 3, 1926.

the gasoline they probably will carry away entrained liquid.

Third, the gasoline should not be discharged into the run down tank as a spray for this causes much gasoline to be carried out as entrained liquid by air and gas circulation.

Fourth, the run down line should be painted a light color to lessen heat absorption. This factor is of importance in long run down lines during the hot summer months. In several instances the temperature of the gasoline entering the tank was found to be four or five degrees F. higher than that of the stream at the look box.

Even with vapor tight tanks there is a considerable loss from run-down tanks due to the displacement of vapor laden air which is forced out of the tank as it is filled with gasoline. This loss is important since run down tanks are often filled and emptied several times a day. To reduce this loss some refiners connect their run down tanks with overhead vapor lines, so that as one tank is being filled the displaced vapor enters a tank that is being emptied. Even with this system there is some loss, for there will be periods when the system will not be in equilibrium and vapors will be given off or air taken in. Floating roofs, breather bags, and vapor recovery systems reduce the filling losses to a greater extent than connecting the tanks in series with overhead vapor lines, for these systems prevent the discharge of vapor air mixtures to the atmosphere.

Evaporation Losses During Treating

The largest evaporation losses in treating gasoline are found in the old type batch agitator, using an air blower for mixing the chemicals with the gasoline. Tests on this type of equipment show average evaporation losses of about 0.5 per cent.

Tests made on batch agitators equipped with circulating pumps for mixing the chemicals and gasoline show an average evaporation loss of about 0.2 per cent.

Some refineries have continuous treating plants which are entirely enclosed, so that the gasoline does not come into contact with the air, therefore there is no evaporation loss.

Reduction of Losses in Filling

The average evaporation losses in filling tank cars with gasoline are high because of the gasoline is shipped during the hottest period of the year. To reduce evaporation, some refiners load their most volatile products at night, or spray the cars with water if loading during the day. Both of these methods reduce evaporation losses, but it is not practicable to do all loading at night, and it is doubtful whether a water spray is always economical.

Many factors affect the rate ofevaporation during the loading of a car. Besides the character of the gasoline and the atmospheric conditions, one must consider the temperature, also the rate and method of filling the car. Formerly it was the practice to have the loading line extend only a few inches into the dome and allow the gasoline to splash into the car. This is a very wasteful practice, for it allows the air in the car to become rapidly saturated with gasoline vapor, and permits air currents to carry away the saturated air and entrained liquid. Most refiners now use a sleeve which is attached to the loading line and extends from the dome to the bottom of the car. This reduces the loading loss considerably, as splashing is eliminated and air currents do not make such intimate contact with the gasoline. However, it is doubtful if this practice alone reduces the evaporation losses to the economic limit. Tests made to determine the evaporation losses with this type of equipment show a loss of 0.5 per cent.

The average evaporation loss of gasoline in storage has been estimated to be 2.5 per cent. The use of vapor tight tanks for reducing this loss is very common consequently the suggestions pertaining to tank grades and to the location of gage hatches and other tank fittings apply to large storage tanks even more than to run down tanks. There are some other factors to be considered however, which though applicable to all classes of tanks are of especial application to storage tanks.

Roof Design

The first of these is the design of the roof itself. Formerly it was the practice to design a tank roof with a high cone or dome, thus allowing a large vapor space above the surface of the liquid, even when the tank was full. As the volume of the vapor expelled from the tank when breathing is dependent upon the volume of the vapor space (other conditions being equal), the smaller the vapor space the less of the vapor and air mixture will be expelled.

The second factor is closely allied to the first. Tanks for storage should be built for average working conditions. In other words if for a certain product 5000 barrels storage is ample most of the year it is a mistake to build one 10,000 barrel tank to allow for excess storage for a short period. It is better to build two 5000 barrel tanks. In a 10,000 barrel tank half full, there are stored about two and one-half barrels of gasoline per square foot of evaporating surface, while in a full 5000 barrel tank there are about five barrels per square foot. In addition it must be remembered that the lower the level of the liquid in the tank the greater the volume of vapor space.

Another factor is the connection of the roof plates with the top angle. It is now considered the best practice to have the top angle inside of the top ring, for by

Pigue Is New Advertising Manager

The Gulf Publishing Company, publishers of THE OIL WEEKLY, THE FILLING STATION and THE REFINER AND NATURAL GASOLINE MANUFACTURER, specialized journals covering the three major branches of the oil industry, announces the addition to its staff of W. W. Pigue, who effective February 15 becomes Advertising Manager of the three publications.

Prior to coming to the Gulf Publishing Company, Mr. Pigue was Advertising Director of the Houston Post-Dispatch. He has also served in a similar capacity with a number of other large daily newspapers and has a wide knowledge of advertising.

Mr. Pigue in his new connection will maintain headquarters at the company's home office, 1716 Dallas Ave., Houston.

He succeeds R. E. Connell who has resigned to become Sales Manager of the General Machine Works of Houston.

W. W. PIGUE

Mr. Connell has been connected with the Advertising Department of the Gulf Publishing Company for the past five years and has a host of friends among the various branches of the industry. He will expect to keep up his contact with these friends in his new position with the General Machine Works which manufactures a line of equipment used by refiners and pipe line concerns.

Alfred Butcher, who has entered the consulting engineer field at 20 Roselle Avenue, West Roselle Park, New Jersey, has recently introduced with success an economical steam oil burner which atomizes one pound of oil for each 14/100 of a pound of steam used. Tar from the refineries is used as fuel in the new burner. The burner is now being used extensively throughout the New England States. Butcher is well known as a refinery engineer having served the Gulf Refining Company at Port Arthur, Texas, and Bayonne, New Jersey, the Atlantic Refining Company at Philadelphia.

this means the seams may be caulked after all rivets are driven. The roof plates are also of sufficient thickness to insure a good caulking edge. With "all-welded" roofs these features do not have to be considered.

Swing Line Hatches

On the old type storage tanks the swing-line hatches were situated upon the roof and consisted of an iron box containing the winch and covered with a hinged lid which was never vapor tight. The best practice is to have the swing line enter the tank through a stuffing box. The winch may be placed on the tank roof; the customary practice, however, is to place the winch on the bottom ring of the tank so that it can be operated from the ground.

Thief and Gage Hatches

Thief and gage hatches formerly used consisted of holes cut in the roof and covered with tin caps. No attempt was made to make them vapor tight. Now it is customary to install self closing thief hatches although many companies use a flange and plug. This gives satisfactory service, especially on tanks that are gaged only once or twice a month.

There are now on the market several gaging devices to determine the liquid content of a tank that eliminates the customary gaging with a steel tape. These devices are gaining favor on pressure tanks containing very volatile gasoline or tanks requiring frequent gaging. The use of such devices saves time besides eliminating the necessity of opening the gage hatch on the tank.

There are two principal types of these gaging devices. One consists of a float that rides on top of the oil and is attached to a cable. The other end of the cable is attached to a metering device on the outside of the tank. The second type of gaging device is based upon the pressure exerted by the column of oil upon an air chamber in the bottom of the tank. The pressure is transmitted to a mercury column graduated in feet and inches or in barrels.

Vent Lines

Formerly storage tanks were equipped with four inch vent lines, the number of vents depending upon the size of the tank and on its use. Often these vents consisted of short pipes on top of the roof, however, to comply with insurance regulations they usually were carried outside of the fire dyke and equipped with fire screens. From the standpoint of preventing evaporation this type of vent is not satisfactory; first, when a tank is equipped with two or more vent lines on opposite sides of the tank there will often be a flow of air into one vent and out of the other due to differential wind pressures. Second, this type of vent line is liable to become clogged so that it does not function properly. Instances have in fact been reported where the roof was pulled in on emptying the tank. Many companies are now installing a single vent line of large capacity. This slopes down from the roof at an angle and there are no sharp turns or bends that may become clogged.

Vacuum and Presure Relief Valves

With vapor tight tanks much care has to be used in the selection of vacuum and pressure relief valves or vent lines. These must be of sufficient capacity to take care of the excess pressure or vacuum under the severest conditions.

Two of the principal factors that determine the volume of air-vapor mixture that must be moved into or out of the tank are: first, rate of filling or emptying a tank, each barrel of oil displacing 5.6 cubic feet of vapor. Second, the maximum temperature change per hour when the tank is nearly empty. Rapid temperature changes are usually caused by a sudden rain or thunder storm on a hot day, which results in a rapid lowering of the temperature. This causes a flow of air into the tank. The writer has noted several instances of a drop of 35 or 40 degrees F. in the temperature of the vapor space within an hour. Relief valves must be ample to take care of both these factors at the same time—that is, rapid emptying of the tank plus a sudden change in the temperature. It is advisable to obtain data from the valve manufacturer showing the capacity of the valves for valves of the same size but of different manufacture because of differences in construction, may not have the same capacity. A 33 day evaporation test was made to compare two 66,000 barrel gasoline storage tanks. One tank was equipped with a free vent line and during the test lost about 120 barels; the other was equipped with a vacuum and pressure valve and lost about 95 barrels. Vacuum and pressure relief valves eliminate diffusion and reduce breathing by eliminating the movements of vapors into and out of the tank due to minor atmospheric changes.

Tank Paints

There is no need to discuss in detail the effect of tank colors on evaporation losses, as it has been well established that light colored paints greatly reduce the rate of evaporation because they lessen heat absorption.

Cooling Systems

Water cooling systems, such as water sprays and water seal roofs are used by many refiners. The successful use of a water spray depends upon a cheap supply of water and though a large amount of water is required they have a maximum cooling effect. The sides or shell of the tank is also cooled by a water spray. In order to obtain the maximum effectiveness, water sprays should be so placed that wind and air currents will not carry the water from the tank roof, thus wetting one part of the roof only. One refiner has successfully solved the problem of wind or air curents by completely covering run down tanks with burlap on a wood frame. The burlap acted as a wick, thus distributing the water over the entire tank. A water spray on a tank that is not vapor tight is usually a waste of money.

Water seal roofs by nature of their construction insure vapor tightness, also as compared with umbrella and cone roofs they reduce vapor space to a minimum. The temperature of the vapor within the tank, however, cannot be less than the actual temperature of the water circulated over the roof.

Insulation for tanks is generally a permanent fixture. The initial cost may be rather high but the operating cost is negligible. If the tanks are completely insulated without an air space, gasoline to be stored in them should be pumped in at the lowest temperature practicable.

It is believed that types of insulation with an air space between the insulation and the tank, or insulating the roof only, are in general more satisfactory, for gasoline may be cooled in such a tank even though it be pumped in at a relatively high temperature.

Through the courtesy of one of the larger refining companies the writer was given the results of an evaporation test made on gasoline storage tanks equipped with two types of insulation. The tanks were of all steel construction, 90 feet in diameter, by 30 feet high and painted grey. Observations were taken for a period of about 268 days, on four tanks. One with an old uncaulked roof showed a loss of 4.84 per cent; another with a caulked roof, 3.36 per cent; the third with an insulated roof, 2.22 per cent. The fourth was an all steel tank protected with an insulated tank house, or hood, painted black. It showed a loss of 1.92 per cent.

Vapor Recovery Systems

Some refiners equipped to recover gasoline from uncondensed still vapors also recover vapor given off from their storage and run down tanks.

The recovery plants are either of the compression or absorption type; many of the smaller ones are modifications of the absorption type. In them the vapors are passed through absorption towers containing naphtha which extracts the gasoline. The gasoline extracted from the vapor enriches the naphtha so that it may be sold as a gasoline blend.

These recovery systems apparently give good results, however, care should be taken to prevent the "remaking" of the product. Usually each tank in a vapor recovery system is equipped with vacuum and pressure relief valves, if vacuum is held on the tank there is likely to be a flow of air through the vacuum relief valve to the gathering line. This accelerates evaporation and though the gasoline evaporated is recovered it is a "remaking" of the finished product. In order to eliminate this problem the system should be so constructed that the vapor from the

tanks be discharged into the gathering system under a slight pressure. In all recovery systems the writer has investigated the tail gases were included so that it has been impossible to obtain definite data regarding the efficiency of the system. Through the courtesy of one refiner, the writer was allowed to see plant records which showed an overall refining loss of less than one per cent.

Breather bags are a modified form of vapor recovery. In an article[1] on this system, it was shown that evaporation losses from gasoline storage tanks were reduced from .25 to .04 per cent per month throughout the storage period.

[1]Wilson, Atwell, Brown and Chenwick, A new method for the prevention of evaporation losses from gasoline storage. Industrial and Chemical Engineering. October, 1924.

Floating Roofs

"Floating roofs" have been in use for some time in refinery tanks. A floating roof rides or floats upon the surface of the liquid in the tank, thus eliminating practically all vapor space. The writer has made tests comparing tanks equipped with floating roofs and tanks equipped with canopy roofs. Gasoline with a gravity of 62 degrees A. P. I. was used in these tests The results showed that for a canopy roofed tank the filling loss was .17 per cent, while a tank equipped with a floating roof had a loss of .04 per cent. Since these tests many mechanical improvements have been made in floating roofs.

Conclusion

It is not possible in a paper of this length to go into the details of the various tests that have been made of systems used to decrease evaporation losses. It is possible to save at least 50 per cent of the ordinary evaporation loss by means of vapor tight tanks properly equipped and between 80 and 90 per cent with the more expensive and elaborate systems. Irrespective of the system adopted the results obtained will depend to a large extent upon the care given the equipment and on careful operation. In other words, the most inexpensive systems properly cared for may give better results than a more expensive equipment which is allowed to shift for itself.

Number Four—The Gasoline Circuit

WHO CAN ANSWER?

This task of handling copy becomes largely a matter of routine. It is picked up, scanned, marked to please the printer, a heading prepared and sent to the plant. Nothing startling anywhere.

Then along comes a question to jolt the brain cells. Otto Peters asked it in this bit of copy. It jerked out of the humdrum class.

"Just what is gasoline?"

When a man finds a satisfactory answer to that he will have done enough thinking to learn something about the process that makes it.

Think it over.

The Editor.

WE study this circuit from the accumulator tanks to the storage tanks inclusive.

Excessive amount of water in the accumulator tank is accepted as an indication of air being in the gas. Air mixed with gas introduces a hazard in plant operation by forming an explosive mixture, but we must also keep in mind that however small the air percentage is it affects production, in fact its harmful effect is cumulative. Another possibility causing excessive water in the accumulator tank is leaky gaskets on the compressor cylinder. We have given thought to the proper piping and maintenance of accumulator tanks, and find in general practice that the gasoline made in the accumulator tank is automatically discharged from it to the storage tank by means of a trap designed for that purpose, usually in the form of a bucket type. It is also general practice to connect the traps to a common header line to the storage tanks, and the storage tanks are usually manifolded, one line from the low stage accumulators and one line from the high stage, so that in event of trouble with either line one line will serve for both. The piping of the traps, lines, and storage tanks, should be carefully considered as leaks in this circuit are costly and dangerous and to properly pipe this circuit is an art when you try to do it according to the rule told you in circuit No. 1.

One of the greatest, if not the greatest source of danger in a gasoline plant, is stiff connections in pipe work. Plant operators should always seek to eliminate danger and costly maintenance, and to help you see these circuits as I do, there is a simple rule to follow in the piping of any circuit, and that is, lay the line straight and at right angles, use tees and bull plugs, start and finish the line with a nipple, gate and union. This provides half swings at turns, either over or under clearance, and leaves the line accessible for inlet or outlet connection and for quick repair. You know how disappointing it is to find an ell where a tee should be, and keep in mind it is not enough to stop leaks, the idea is, prevent leaks. Of course it rests with your judgment, the object of this article is not to tell you what to do, nor what I am doing, it is simply to give thought on the piping of a circuit and in this circuit we must keep in mind not only the manipulation of the storage tanks, but also the troubles in this circuit, particularly during the winter months.

We have in mind that this circuit No. 4 is the gasoline circuit of the compression plant, so that there would be three products, the low stage make, the high stage make, and drip gasoline gathered from the field lines. The drip gasoline would be treated for off-color by either fire still or steam still, and the gasoline made, after being trapped from the accumulators into the storage tanks would be held under pressure at from 15 to 25 pounds gauge pressure. The entire product would then be weathered either under atmospheric conditions or by steaming in order to meet shipping requirements, although blending by different methods has also been resorted to. Of course in the study of this circuit we must keep in mind that different locations present different problems, also different products so that where in circuit No. 1 we studied the gas constituents it would be well to now look up the constitutents found in gasoline and also the properties of gasoline.

When the technical man tells us about hydrocarbons, constitutents, affinities, critical temperatures, partial pressures, latent heat, molecular weights, it is somewhat confusing, and then when our instructions are to watch the G. P. M. in the tank cars, we sure have an exciting time. The practical man should approach this study carefully, he who is most familiar with plant circuits will more readily comprehend what the techniacl man tells about gasoline, and to understand gasoline is a study in itself. Take six of the constituents of natural gas, take six of the constitutents found in gasoline, study the properties of gasoline, then try to interpret the distillation sheet of your plant make. The practical plant operator will find the study of gasoline an interesting one, but do not for one minute think that the tank car holds just so much gasoline, the time is coming when each constituent of that gasoline will afford by-products.—Try to answer this—just what is gasoline?

Bulletin Service Helps Promote Safety in California

Richmond, Calif.—The safety division of the Richmond Refinery, Standard Oil Company (California), as a part of the regular bulletin service recently started the practice of posting bulletins showing the standings of all departments of the refinery in "Man-Davs without a Lost Time Accident."

This bulletin service has stimulated interest in safety and has been the means of promoting considerable friendly rivalry among all concerned. In case of accident, the department in which the accident ocurs drops to the bottom of the list and only by having a clear record is it able to work up to the top again.

Things to Remember About a Belt

Proper installation and proper care insure long life for this type of power transmission

By Roye Munsell
Staff Representative

THIS is to be a brief discussion of some standards of practice as regards the use of belting as a method and means of transmitting power. It ought to be said at the outset that the writer holds no brief for any particular kind or make of belt, or belts in general as a power transmission connection.

The best belt will rather ambiguously be defined as the best transmitting connection between supplied power or drive pulley and applied power or driven pulley. The performance of a given belt as a transmitter of power is only to a limited degree dependent upon the trade-mark which happens to appear on that belt, the large consideration, it is believed with any belt, is application and method of use.

If the pulleys are too small or too narrow, if the speed of movement is extremely low or too high, if the surface of contact on the pulleys is inadequate, no belt, no matter what its characteristics, will be efficient and economical.

Conditions

A belt is a band and how well it performs its duty, i. e., transmits power, depends upon:

1. Tension of belt.
2. Coefficient of friction existing between belt and pulley.
3. Speed at which belt is run.
4. Arc of contact, or the arc of the pulley which is embraced by the belt.

A belt transmits power because of its frictional contact with the face of the pulley. Since the belt must grip the pulley in order to turn it, it ought not to be inferred from that that the amount of power transmission may be effectively increased by increased tightness of the belt. Now to a certain extent it is true that a belt will transmit more power the tighter it is applied to the pulley. It is true that if a belt just lies on the pulleys very little power will be transmitted; when tightness is increased, the power transmitted increases, but not to a corresponding degree, however. There is a point, furthermore, beyond which no increase in tightening will increase the power transmitted but rather decrease it.

This rather paradoxical result is probably due to the extreme pressure of the belt on the pulley changing the nature of the surface of the belt.

Not Too Tight

A surface which is "wooly" or "hairy" such as a belt is shown to be under a microscope, will bed down under pressure, it is recognized. At a slight pressure the greatest number of these projecting bodies will impinge on the surface of the pulley, and the contact will be most efficient. Under excess pressure, it follows that these projections will tend to flatten and offer little resistance to the movement of the surface of the pulley over them. This is the slipping point.

A homely illustration of this phenomenon can be gotten from a common clothes brush when it is moved over a comparatively smooth surface with varying degrees of pressure.

Long before the point has been reached where increased tension fails to increase power transmittal, there has been a damaging strain put upon the shafts and bearing, as well as the belt itself.

A tight belt "pulls" on bearings making them obviously harder to turn, and this increases its own load.

If a belt must be drawn more than moderately tight to get it to work, it is likely that there are other details to receive attention first. More about this will be said presently.

Giving a Rest

A belt which runs loose, will of course have a much longer life than one which is drawn tightly. A belt running slack on one side automatically relieves itself of the effects of the driving strain when travelling on that side. This is a "resting space" during which the belt can relax and return to its natural condition.

In a general way, it can be said that if a belt is run loosely one can be sure that he is not injuring it and lessening its ultimate driving power.

Every belt has a proper tension under which it ought to be used. This will vary according to its character and the operating conditions. As a rule, so long as a belt will start its driven pulley easily it is tight enough for work. That is not to say that a belt should be run so loose that it will wobble and wave, still it should be slacked to the point where it travels quietly and without flopping from side to side, and yet carry the load.

If a belt slings from side to side and a flapping fold forms between the driving and driven pulley, there is scarcely anything to do but take it up at the fasteners. There is no reliable substitute for the "knife."

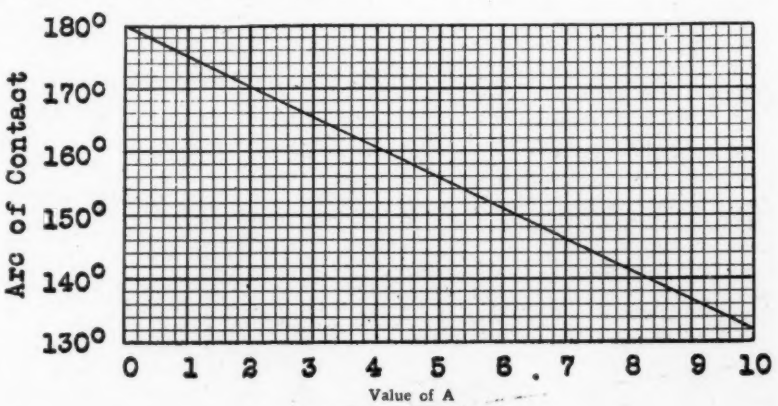
Placing the Idler

Idlers, except where necessary because of the nature of the drive, are not always to be desired. If an idler is applied with the aim of increasing tension the best place is near the smaller of the two pulleys.

Practical experience has shown that an idler should in no way increase the strain on the fasteners or the load on the bearings. The proper and very good use of an idler is to increase the wrap of the belt on the pulley—the arc of contact.

The driving power of a belt, other things being equal, is commensurate with the arc of pulley contact. It is almost safe to say that any increase in arc of contact will result in a proportionate increase in the efficiency of operation.

The part which the arc of contact



Arc of Contact chart

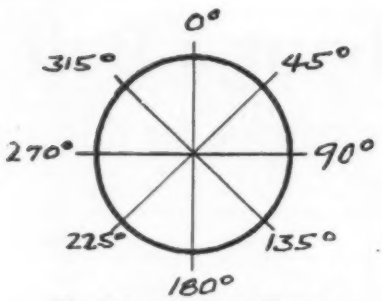
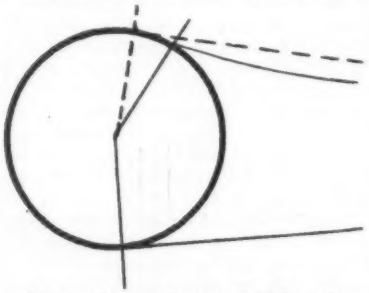


Fig. 2—Arc of Contact Diagram

plays in the performance of belt transmission is shown by the following table which gives in a practical way the percentage of horsepower transmitted by the most easily obtainable arc of contact. A contact surface of 180 degrees is used as a basis.

Arc of Contact of Smaller Pulley	Percentage of H. P. Transmitted
90	50
100	56
110	61
120	66
130	72
140	78
150	83
160	89
170	94
180	100

There are several common ways of finding the arc of contact of the smaller



Relative Arcs of Contact of Tight and Loose Belts

pulley. One of the simpler methods is by the formula:

$$\text{Arc of Contact (in degrees)} = \frac{180 - 57.3\,(D - d)}{C}$$

C=Distance between centers.
D=Diameter of large pulley.
d=Diameter of small pulley.

First, multiply the difference between pulley diameters by 57.3, divide the product by the distance between centers, and then subtract the resultant quotient from 180. The difference is the arc of contact in degrees.

Another way of arriving at the same figure is by some such chart as is shown in figure No. 1.

In practice the ideal driving side is

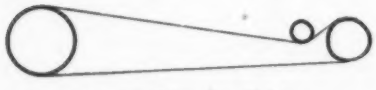


Fig. 4—Idler Too Tight

the lower side since the sag on the upper side increases the arc of contact of both pulleys by just that much. This effect is not secured, however, if the belt is run tight.

Place of Speed

Another factor affecting the transmitting power of a belt is the speed at which it is run. Additional speed will, up to a certain point, increase the power delivered, but the best speed, considering the life of the belt, is probably a moderate speed, rather than a very high speed.

There are distinct limits to the speed at which a belt should be driven. Some-

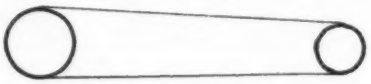


Fig. 5—Too Much Tension

where around 400,000 feet a minute is, no doubt, the highest rate advisable for most belts.

With the ordinary drives used at refineries and natural gasoline plants, where velocity of the belt is not great, it is not necessary to consider the effect of centrifugal force or the tendency of the belt to always keep moving straight ahead rather than curve around the pulley. As the speed of the belt increases the centrifugal force increases and its effect is a difficult matter to contend with.

The common cause of fluttering is the air cushions which are formed when the centrifugal force keeps the belt off the pulleys. A belt made thick enough and heavy enough to prevent fluttering under this condition is certain to be to thick to be sufficiently flexible to perform well.

About the only way to make a high speed belt work well is to select a light one that will take as easily as possible the incessant and rapid bending without undue distress, and then increase its tension to the point where it will hug the pulley without unnecessary strain.

On fast moving pulleys the centrif-

Fig. 6—Belt Too Loose Flaps and Runs Off

ugal effect of the belt ought to be taken into consideration in determining the width, etc., of the belt to be used.

Smooth Pulley Best

There is, or rather was, a theory in much vogue that a belt would do more work on a rough pulley than on a smooth one. Tradition has it that one of those who championed this theory obtained his data with a shoe string and a napkin ring. It seems that this particular individual found that the shoe string pulled harder on a particularly rough section of the napkin ring and from this very good bit of empiricism postulated again the theory that perfectly smooth pulleys are less effective and roughness is, therefore, to be desired as an aid in the transmittal of power.

Actual tests have shown the very opposite to be true. Smoothest pulleys drive best, but the smoothness insisted on here must not be taken to mean "slipperiness." It is well known that the belt and pulley surfaces after working together for a while assume a smooth appearance, taking hold best in proportion to the smoothness they acquire.

The smoother the surfaces, the greater the actual contact between the belt and pulley and the more particles of each impinge on the other. Also, if the surfaces are smooth less air will be caught between the belt and the pulley, the air acting to cushion the belt from the pulley.

It has been found that the application of a coat of varnish to a pulley will greatly increase its driving power. To go about doing this, the pulley is first thoroughly cleaned of oil and belt dressing with gasoline. Then a solution of muriatic acid is applied and allowed to remain on until a slight coat of rust has been formed. After the excess muriatic acid has been washed off and the pulley thoroughly dried, a coat of white lead paint is spread on. Following this, three coats of a good grade of varnish are put on, al-

Fig. 7—Approximate Tension for Economical Drive

lowing sufficient time for drying between coats and before the belt is put back on. This varnished surface is almost ideal for the face of the pulley.

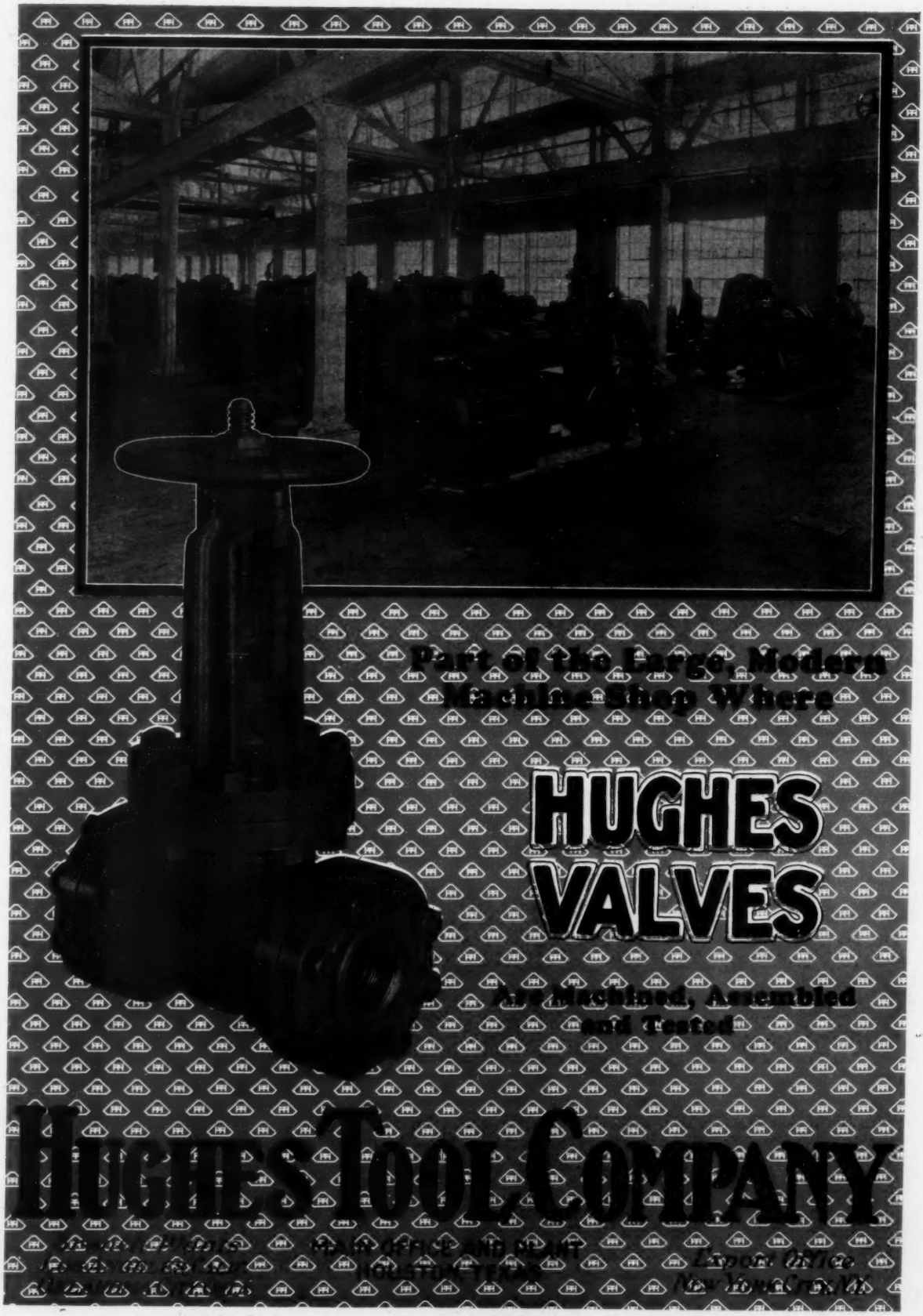
Another common source of lack of sufficient contact between pulley and belt is a stiff, unyielding belt. Such a belt fails to hug and engage the pulley, and rides up, cushioning in places on the air caught between it and the pulley surface.

The Salesman Knows

If a belt is of the right thickness, the remedy is some form of a dressing. A dressing must, however, not make the belt "sticky" or "tacky," but only soft and pliable, still not spongy or flabby.

The best rule in using a dressing is to follow the recommendation of the belt manufacturer. It can be expected that he will not furnish or advise anything which will contain harmful ingredients, but a preparation that will carry certain elements which are also preservatives to add life to the belt rather than shorten it.

In conclusion it might be said that of all these factors which contribute to the good driving performance of a belt, giving it more tension is the poorest. Give it more arc of pulley contact, run it faster, improve the driving surface



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of the pulley and the belt, and increase tension last, if at all.

Know the Pull

In selecting a belt for a particular drive it is well to consider first the nature of the power pull which will be encountered. There are two kinds of power pull—a steady, even pull and a

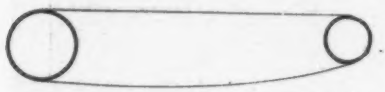

Fig. 8—Sag on Lower Side Uneconomical

jerky pull. Each requires a belt with certain characteristics to secure the best operation and performance.

A belt for a strong steady pull must be of such a nature as to resist strain and minimize stretching. If this belt were used on a jerky pull, though, it is almost certain to be of short life if not soon broken.

A belt for an interrupted pull, such as one finds on compressor jobs, must be springy so it will stretch at the load peaks and recover thereafter. This is necessary to secure an even drive.

Belts and pulleys should always be kept as clean and free from dust and oils as possible. Some oils particularly mineral and animal, are very destructive to most belts.

Without consciously going counter to the recommendations of the belt manufacturers, soap and water is very good for cleaning rubber belts. If a scraper is necessary also, care ought to be taken not to scratch or cut the surface of the belt.

If a leather belt has become oil soaked, Fuller's earth, by virtue of its properties of absorbing oily substances, is sometimes used to clean the surface. After being left on for a time, it is removed with a dull wooden blade.

A leather belt is most effectively cleaned by soaking in benzine or gasoline and then rbbing and scraping the oil out. Before being used again, it is imperative, however, that the belt be redressed well.

To Find Length of Belt

The most exact way to find the length of belting required on a certain drive is to use a steel tape line. To use twine or light cords is risky business because it is sure to stretch just a little.

If conditions do not make possible the use of a steel tape, the length of the belt may be calculated as follows:

A. If pulleys are of same diameter.
1.—Multiply the sum of the diameters by 1.57.
2.—Add twice the distance between pulley centers.
The result will be the total length of the belt required.

B. If the pulleys are of different diameters
1.—Multiply the sum of the pulley diameters by 1.57.
2.—Multiply the distance between centers by 2.
3.—Square the difference in pulley diameters and divide by four times the distance between pulley centers.
4.—Add together the results of steps 1, 2, and 3.
The total is the length of belt required if the diameters of the pulleys are not the same.

To Find Length of Crossed Belt

If the belt is to be crossed, the length can be found as follows:

A. If the Pulleys are of the Same Diameter

$$1.57\ (D_1+D_2)+2\sqrt{D^2+C^2}$$

D=Diameter of pulleys (both same)
C=Distance between centers in feet.

B. If Pulleys are of different diameters.

$$1.57\ (D+d)+\sqrt{(D+d)^2+4C^2}$$

C=Distance between centers in feet.
D=Diameter of large pulley
d=Diameter of small pulley

Length of Belt to Be Changed

When the length of a belt is to be changed because of changing the size of pulleys used, the amount to be added or cut off is found by simply remembering that 1½ times the difference between the diameters of the pulleys in inches is the change to make in the belt. In changing to a larger pulley the amount arrived at is added and in changing to a smaller pulley it is cut off.

To Find Length of Belt in Roll

When the belting is tightly rolled, the amount in the roll can be very easily calculated. This saves time both in seeing if the length in a roll is sufficient for the job at hand and in taking inventory of stock.

The steps are:
1,—The sum of the diameters in inches of the outer and inner coils are multiplied by .1309
2.—This figure is multiplied by the number of coils in the roll.
The result is the total length of the roll in feet.

The formula is:

$$L=.1309\ n\ (D+d)$$

L=Length in feet of the roll.
n=Number of coils in the roll.
D=Diameter of outer coil.
d=Diameter of inner coil.

Fig. 9—Centrifugal and Centripetal Forces Diagramatically Shown

Acid Proof Paint Will Cut Down Corrosion Losses

What is said to be an effective acid-proof paint has been perfected by the International Compositions Company, Inc., No. 25 Broadway, New York City, and the product is soon to be released for the consideration of the industry.

This paint is said to be especially adaptable to the petroleum industry inasmuch as it is expected to make possible tremendous savings in tankage, transportation facilities, etc., by cutting down corrosion losses.

The principal advantage of this paint, according to its manufacturers, lies in the fact that it is not soluble in petroleum or any of its derivatives. This makes it impervious to sulphuric and hydrochloric acids, both of which are likely to get into contact with the steel structures used in the handling of oil.

The new paint is introduced under the name of "Rubshell," and so far has satisfied the manufacturers that it possesses all the qualities needed for combatting the corrosion problem.

Free test samples are being distributed through Messrs. J. A. Rossiter, Inc., 410 Union National Bank Building, Houston, Texas.

Qualities of "Rubshell," as outlined by the company are as follows:

It is permanently proof against the action of diluted sulphuric acid, such as is apt to form in the tanks of tank steamers, also against the condensed fumes of the same under decks, hatch covers, etc.; it is entirely insoluble in petroleum, benzine, or any petroleum derivative; it is quick-drying and can be applied without danger of explosion in the tanks of steamers, providing ordinary ventilating arrangements can be adopted; it has good adhesive qualities to the surface of steel plates.

The solvent in the new paint is alcohol and its principal constituent is a new synthetic gum.

More information will be supplied by the company or its agent, as listed.

Metallo Gasket Catalog

Metallo Gaskets are recommended where high steam pressures and high temperatures exist and there is need for gaskets. The Metallo Gasket Company, 12 to 20 Bethany Street, New Brunswick, New Jersey, has just issued Catalog No. 26 which describes gaskets manufactured by the company. Copies of the catalog will be mailed upon request.

Advantages of Celite

Advantages of Celite, an admixture for concrete, manufactured by the Celite Products Company, 1320 South Hope Street, Los Angeles, are stressed in bulletin No. 314, recently published. Copies may be obtained from the company, on request.

A Paint Organization

Known to the oil industry as manufacturing protective coatings of every character from the pipe lines in the ground, the tanks, etc., at refineries, to delivery trucks, tank cars and filling stations.

A personal service organization made up of field and manufacturing men in daily, practical, contact with oil industry problems.

Our greatest satisfaction is the continuous commendation of users of our products over a period of years.

American Paint & Supply Co.

Dallas, Texas

C. H. Seabrook, *Vice-Pres. & Gen. Mgr.*
Al. H. Reed, *Sales Mgr.*

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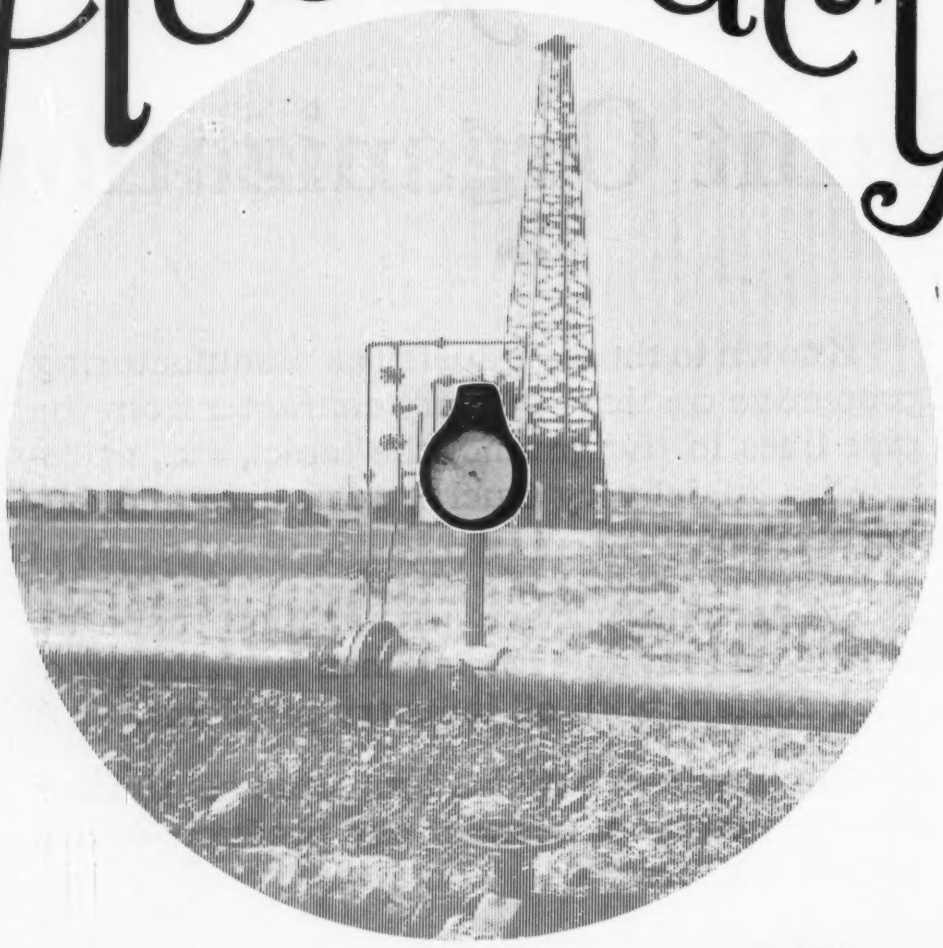
Accuracy



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Stills Fired in Argentine Refinery

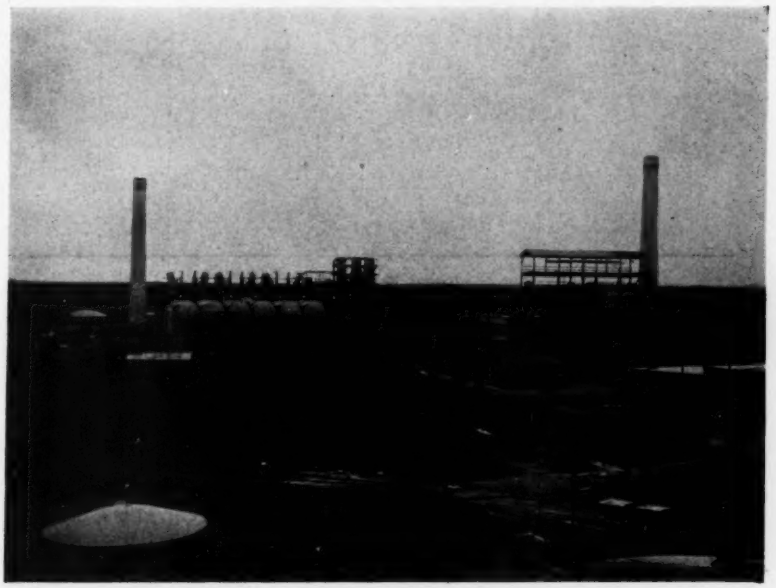
Plant in La Plata will be charged with crude from government fields at Comodoro Rivadavia

Buenos Aires, December 24.—President Alvear, accompanied by many important government officials, has officially inaugurated in the city of La Plata what is considered to be one of the ten greatest refineries of crude petroleum in the world. While all sections of the plant are not yet completed, work started yesterday in the first unit, which has a capacity of 2000 tons of crude oil daily.

The refinery has been constructed for the Argentine Government in order to refine the crude oil from Comodoro Rivadavia. The work has been in the hands of the Bethlehem Steel Company. In commenting on the efficiency and success with which the work has been carried on, La Prensa, the principal newspaper of Argentina, says that this is probably the first time that any public work in Argentina has been completed within the time provided for in the estimates. It was planned and executed as a result of the initiative of the former minister of agriculture, in whose department lies the control of the government's petroleum industry, Dr. Tomas Le Breton, former Argentine ambassador in the United States.

The contract of the Bethlehem Steel Company called for the erection of tankage, warehouses, machine shops, boiler and pump houses, garage, laboratory, packing plant, electric power plant, topping plant, redistillation plant, cracking plant, etc. The site chosen was the harbor front at La Platte, where tank steamers from Comodoro Rivadavia can discharge their cargoes direct into the refinery storage tanks.

The estimated cost of the work when the contracts were let was 21,759,629.35 Argentine pesos, or more than nine and a half million dollars. In the preliminary studies prepared by the director of the government's petroleum industry, Coronel Mosconi, it was calculated that there would be at the disposal of the plant about 600,000 tons of crude oil annually from Comodoro, and that this could be made to yield 7 per cent of naphtha, 7 per cent of perosene and 26 per cent of gas oil. Up to the present time this has been lost because of the lack of adequate refineries. It was also calculated that the operation of the plant would give the government a profit of approximately 12,000,000 pesos a year. The original plans called for the construction of a plant that could handle 2000 tons of crude oil daily, constructed on a plan that would allow the output to be doubled later. Tankage was to be supplied for keeping a thirty days supply.

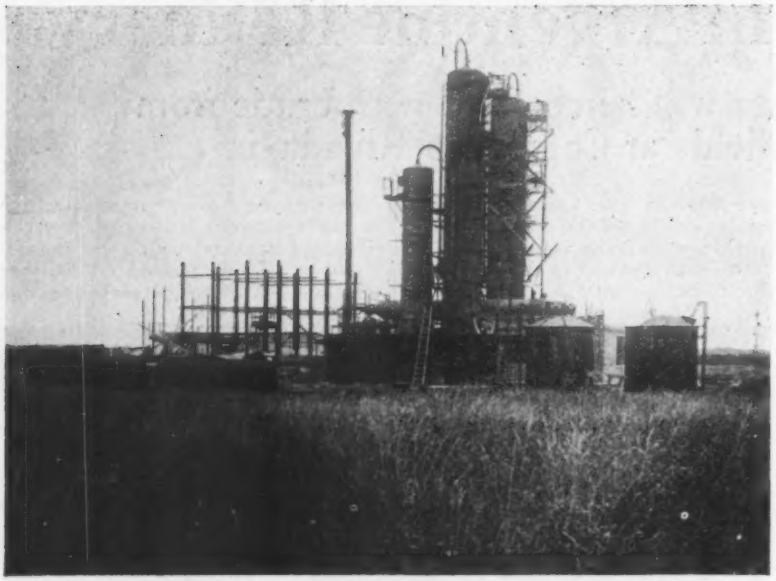


Plant View During Construction

Agitators

A general description of the plant follows:

The tankage provided consists of storage tanks for crude petroleum and also for distilled products. For crude oil there have been installed four tanks of a capacity of 35,000 cubic meters each, with two tanks for the decantation of water with a capacity of 11,400 cubic meters each. For fuel oil there are three tanks of 26,200 cubic meters capacity each. For storage of gasoline there are two tanks 4750 cubic meters each. For kerosene there is one tank of 2380 cubic meters, and for intermediate distillates theer are two tanks with a total capacity of 3180 cubic meters.



Tower Equipment

This equipment is supplemented by a complete pumping system, including five Bethlehem Weir 17x16x30 inch pumps. The tanks are equipped with Amdy fire control apparatus.

The boiler shop is equipped with perforators and cutters for working three-quarter inch steel, a steam hammer that works at 250 pounds pressure, and other apparatus for working three-quarter inch steel up to 12 inches wide. All of the machinery in this shop is operated by an independent power plant. Among other equipment are included machines for working pipe from one to twenty inches in diameter.

The garage has a capacity for 18 vehicles, with equipment for making repairs.

A complete laboratory is also installed.

Other necessary shops, power plants, etc., are provided with the most modern equipment.

The topping plant contains six cylindrical alembics. There are also nine Leach fracto-condensers. This plant is supplied with the latest American equipment throughout.

The redistillation plant has a battery of four alembics. It includes four Gray towers and five Leach fracto-condensers.

The cracking plant will work over gas oil at 450 degrees of heat under a pressure of 45 atmospheres, and is expected to produce 60 per cent of gasoline. A bubble tower and a Gray tower are installed.

Tanks with a total capacity of 20,000 cubic meters are provided for the product of the topping and cracking plants.

A central pumping plant is supplied for moving distillates and oils undergoing treatment. This includes seven Bethlehem Weir pumps of 8x9x18 inches.

Elliott Company Mourns Death of K. C. Manager

Friends of F. H. Penberthy, Kansas City district manager of the Elliott Company, regret his passing, on January 29, in Kansas City.

A tribute to Mr. Penberthy is taken from Powerfax, house organ of the Elliott Company: "On July 1, 1913, Mr. Penberthy opened up the Kansas City District Office for Elliott Company and Associates. At that time our organization having previously had no direct representative in the territory, our companies were not particularly well known. Through Mr. Penberthy's untiring efforts and ability, during the past eight years, he developed the territory to a high rank among our various districts. He was a live wire. He made an enviable record. Of an energetic temperament, he was always on the job, overlooking nothing which might have a bearing on the building up of permanent goodwill and the business in which he was interested. He always gave his customers genuine service, which they appreciated, and they were glad to respond with their business, as well as their personal friendship. He knew power plants; he knew what he was selling; consequently, he was well qualified to advise and work with a customer to the advantage of both parties."

Mr. Penberthy lived in Kansas City the greater part of his life. He obtained the degree of Mechanical Engineer from the Colorado School of Mines.

Several New Units of Dubbs Process Sold

Chicago, Ill.—Universal Oil Products Company, of this city, announces that it has entered into license contract with the Trinidad Leaseholds, Ltd., London, England, for the immediate erection of two Dubbs cracking units at Point-a-Pierre, Trinidad, British West Indies.

The Roxana Petroleum Corporation has also ordered for immediate installation, four additional Dubbs cracking units for their Wood River, Illinois, refinery, and two additional Dubbs cracking units for their Arkansas City, Kansas, refinery.

Griscom-Russell Moves

Griscom-Russell Company has sent out notices of the removal of its general offices from 285 Madison Avenue, New York, to the new Murray Hill Building, at 40th Street. The move was made late in December.

Storage

Contributing Factors to Corrosion With Special Reference to Sulphur

Presented before Western Petroleum Refiners Association, Fort Worth, March 3, 1926

By C. K. Francis,
Petroleum Technologist

THE element sulphur, while absolutely essential to the needs of our daily life when in its proper place, often gets into the wrong company and then it creates so much havoc that it becomes worse than an annoyance. To attempt to illustrate here the remarkable value of sulphur to modern civilization would be needlessly confusing. It is used to make many drugs and medicines. Many of the finest dyes used to produce the beautifully colored fabrics would not be possible without sulphur. If sulphuric acid, which contains a large quantity of sulphur, were removed from commerce and the arts, many necessities of life would become very expensive and numerous fine things would be impossible. Sulphur is found to some extent in plants, but in much larger proportion in animal substances. It often changes form, possibly from good to bad. It is present in the yellow of an egg and is largely responsible, through change of form, for the odor when the same egg is kept around too long.

The presence of sulphur in petroleum will no doubt have considerable bearing on the final decision as to whether the oil was formed from plant or animal substances. Plants usually contain but little sulphur. Those oils containing large quantities of sulphur may have been formed from large animals or a large number of animals. No matter how it got there, that cannot be remedied today, but it is in the oil, so methods must be studied and devised to control and to get rid of it.

There is one phase of corrosion which must be mentioned before considering the main topic of this paper. That is the quality of the material used in the petroleum industry for handling liquids, vapors and gases. Some metals are absolutely unsuitable and should never be considered for permanent installations. This is not because of possible sulphur corrosion but for many other reasons, the chief of which are their characteristic properties. Zinc, copper, aluminum and lead are easily attacked by numerous substances. The water associated with petroleum often contains salts and organic acids which are detrimental to these metals. Combinations of unlike metals, especially when making contact, are bad because of possible decomposition through electrolytic action. If, for example, a piece of zinc or an alloy, should be placed close to iron in a water solution, or maybe in oil which contains particles of water, and then connected in some manner as by a piece of pipe, a current may be produced. Such a condition brings about a double result; a dangerous electric current as a fire hazard and the corrosion of the metal.

Inferior Metal Dangerous

Inferior or impure iron and steel may be likewise classified, for pure iron is known to resist corrosion to a remarkable degree. There are many examples of this in specimens of hand forged articles of iron which were made in the early days of civilization. The iron column of Delhi was erected over 3,000 years ago and it stands today practically without damage after its long exposure to the atmosphere.

It will often escape the consideration of the purchaser of pipe, tankage and other refinery equipment, that the chemical composition of the metal deserves more than ordinary attention. A purity such as that of the wrought iron produced so many centuries ago in India, cannot be expected under modern conditions. However, it is well to be on guard against the presence of those objectionable substances that may be detected by proper chemical analysis. Iron made from low grade ore or under improper conditions and with inferior fluxing materials, may have some place in the industry as window weights, but certainly cannot serve for vapor lines, condenser coils, run down lines and other places where a high quality iron is needed.

These points may be summarized by saying that there are numerous conditions and factors, including the crude oil, water, metals and their combinations, electrolysis and the chemical composition of the iron, which may be contributing causes for corrosion.

First Sulphur

The first petroleum to be marketed did not contain sufficient sulphur to cause damage or to present a serious refinery problem. However, when the northern Ohio oil was discovered it brought a sulphur trouble which has been with the industry ever since. There can be no doubt that the development would have been long delayed had the Ohio oil been brought in ahead of the Drake well. The report by Professor Silliman drew attention to the commercial possibilities of the Pennsylvania oil. While his chemical investigation was largely responsible for the establishment of a great industry, a similar study of the high sulphur oil from Ohio could not have received so favorable an endorsement.

The Ohio oil contained so much sulphur and the odor was so bad that for a long time there was no market for it at any price. The corrosive action of the sulphur on the equipment and the physical discomfort experienced by the workers were indeed serious obstacles to overcome. The control of sulphur in that oil constitutes one of the remarkable achievements of modern industrial research. It was found that the larger part of the sulphur would combine with copper. So when the copper under proper conditions was placed in the still, the oil was purified to such an extent that it could be refined. Through this means the oil found a market.

It is our good fortune that the Mid-Continent oils do not as a rule, contain large quantities of sulphur. The purification process in the refinery is neither seriously complicated nor very expensive. Control or partial removal of the sulphur from the crude oil has a definite influence on corrosion of the apparatus and the quality of the products to be marketed. Sulphur is present, however, in sufficient quantity to do such extensive damage to the refinery equipment as to cause considerable loss and annoyance.

An analysis of the Cushing crude, while one of the best grades, will serve to illustrate how the sulphur is distributed through the various fractions obtained from the original oil.

DISTRIBUTION OF SULPHUR PRODUCTS FROM CUSHING PETROLEUM

The original oil was 37 gravity and contained 0.350 per cent sulphur. All figures in the table are in terms of per cent.

Product	Quantity Obtained	Sulphur Content	Sulphur as Part in Crude	Per Cent of Total Sulphur in Crude
Gasoline	31.77	0.02	0.0067	1.91
Kerosene	18.26	0.05	4 0086	2.45
Gas oil	5.74	0.10	0.0060	1.71
Lubricating distillate . . .	28.19	0.77	0.0970	27.72
Fuel oil	15.21	0.76	0.1156	33.03
Gas and Loss . .	0.83	14.04	0.1161	33.18
	100.00		0.3500	100.00

The separation was made according to common practice, with the use of steam and towers. The products mentioned were obtained by one run and were not treated or purified in any manner. The sulphur is shown to increase in quantity as the distillation proceeds. The lowest percentage being in the gasoline or first fraction, and the highest in the last fraction and the fuel oil residue.

The distribution of the sulphur throughout the entire list of products indicates the necessity for its control, and purification of the products by treating or other methods. While the thought in this paper may be confined to the corrosion of re-

(Continued on page 64)

One of the reasons why it is more profitable to run fuel oil direct to the Dubbs Cracking Process than to skim the fuel oil to get a gas oil distillate for cracking, as is necessary with other cracking methods, is this:

1000 barrels of fuel oil, run through a pipe still, will yield an average of 650 barrels gas oil distillate for cracking and the remainder is heavy flux This 650 barrels gas oil distillate, by any other cracking process will then, in its single cracking operation, produce approximately only 200 to 225 barrels

of gasoline And to obtain this you have the added cost of the pipe still operation

1000 barrels of fuel oil run direct to the Dubbs Process, with *one* operation and *one* operating cost, will give you 500 to 600 barrels gasoline and leave 250 to 350 barrels distillate stock for recracking if desired The remainder is good commercial coke and gas for fuel

Universal Oil Products Company
Owners of the Dubbs Process
310 South Michigan Ave
Chicago, Illinois

Sample Taking in the Oil Industry

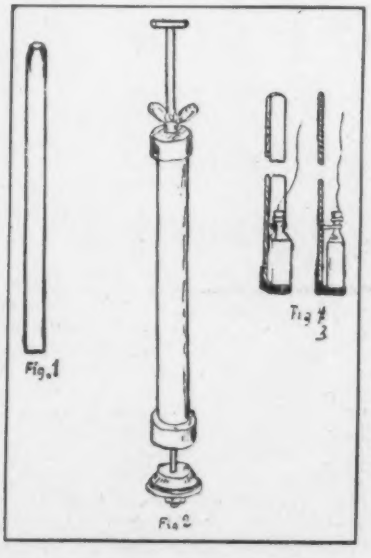
By Ismar Ginsberg

THE success and the value of any analysis depends essentially on the manner in which the chemist or analyst has taken his sample. It stands to reason that no matter how accurately the chemical part of the analysis may have been carried out, if the sample has not been properly taken, the value of the analysis is nil. The essential point is that the sample should be representative, that is it should reflect the conditions that are present in the great mass from which it has been selected, so that the results obtained on this sample may be safely applied to the mass. The theory of sample taking is therefore fairly simple but the practical application of the same is a rather difficult matter at times. It is by no means an easy matter to take the proper kind of sample and at times the analyst is forced to use all his ingenuity to secure a sample which will be approximately representative of the whole.

In the oil industry it is customary to handle very large volumes and masses of products, and it is understandable that the difficulty of correct sample taking is increased due to the size of the mass from which this must be done. Hence it is found that sample taking is frequently a laborious task, one that is not given the proper attention at times, with the result that analyses are made which will not check with those made by others. As those who have been at times in such a confused condition will testify the trouble that arises due to this cause is so great that it would be better not to make analyses at all than to make them on an incorrectly taken sample.

Many Difficulties

Then again the oil chemist must remember that there are many pitfalls which obstruct his path in this work and which will lead him into error if he is not particularly careful. For example just because a tank or tank car is full does not mean that the sample taking has been simplified. For that tank of oil may have stood for a long time, sufficient to allow all the impurities to settle to the bottom, and if a sample is taken merely of the supernatant oil it would manifestly not be representative of the tank car of oil. Sometimes products like crude oil or paraffine oil will contain heavy emulsions and in these there will be contained particles of mineral matters, salt cake crystals and other mechanical impurities and these will naturally settle to the bottom of the tank in time. This may form the bottom layer in the tank and on top of this layer there may be a layer consisting of oil containing a floating and while the topmost layer will persumably contain the pure oil. The taking of a sample under these conditions which will give equitable results on analysis is in reality a very difficult matter, much more difficult than the analysis itself.



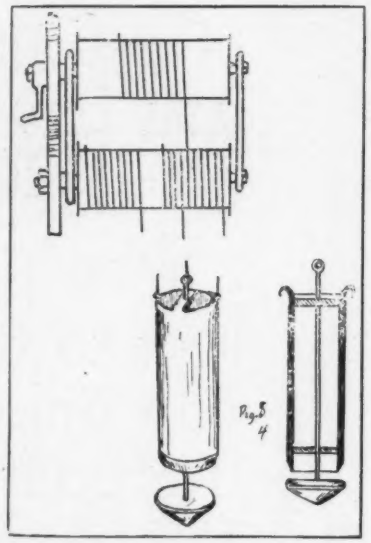
Sometimes when it is desired to find out how much impurities and how much clean oil are contained in the tank, the bottom layer is run off and measured and the next layer is run off as well. But this method is a very poor one, for it is found that there is no sharp separation between the layers and one runs into the other very easily when this method of running-off is employed. Furthermore it is very difficult to run off the emulsion for it is very viscous and at times almost a semi-solid in consistency.

Point One

It therefore follows that the question of sample taking in the oil industry is one of considerable importance and should be of interest to all oil men.

The first point that occupies our mind is the taking of samples from tanks and tank cars.

A method which has been found to give good results and which is easiest to carry out is the use of a thick glass tube of about 15 to 22 millimeters internal diameter and about one meter long, when used in tanks and about two meters long when used in tank cars. After the tube has been washed with petroleum and benzol and then wiped off thoroughly and dried, the tube is sunk in a perpendicular direction right into the tank or tank car until it touches the bottom. (If the tanks or tank cars are of special size, then the length of the tube will of course be greater). The top opening of the tube is then closed by placing the thumb over it and the tube is carefully lifted out of the oil. After the outside has been carefully wiped off with a rag, the contents of the tube in their entirety are allowed to flow into a bottle or flask. After the sample has been taken the tube is cleaned and made ready for the next sample taking. In winter time it is well to warm up the tube before it is sunk into the oil mass. In cases



where important analyses are to be made of the samples, it is best to take several samples with the tube and then to combine them all in one flask, and after thoroughly mixing them to take a sample from this mass for analysis. If it is thought that the sample taken in this manner by means of the sample tube does not represent accurately the contents of the tank, it is wise to take several samples at various parts of the tank so that as comprehensive a sample as possible is obtained. In sampling tank cars the same procedure is followed out.

Figure 1 shows the glass tube that is used in taking the sample. One of the disadvantages of using this sample taking apparatus is that it is necessary to wipe off the outside of the tube in order to remove the oil that adheres to it. This is not so much of an operation when a single sample is taken, but while it is carried out it sometimes happens that the oil in the tube is lost by being poured out. Hence a patented tube has been proposed to do away with this difficulty. This sample-taker is seen in figure 2.

Newer Method

The glass tube in this case is held by metallic rings at both ends. The lower end can then be closed with a cap and this cap is attached to a long wire which runs through the tube and is connected at its upper end with a handle for gripping and a thumb screw, as shown in the figure. The construction is such that air is allowed to emerge unimpeded while the sample is being taken. When for example a thoroughly representative sample is desired, then it is necessary to allow the open end of the tube to enter very slowly into the mass of oil. In this way it penetrates through all the various layers of oil and finally reaches the bottom of the tank. When the sampler is ready to be

drawn out of the oil, it is first necessary to screw fast the bottom cap and this is done by turning the handle at the upper part of the apparatus. The cap must be made of rubber, for there are always present in the oil mechanical impurities which would not allow a metallic cap to fit tightly and effectually close up the sampler, with the result that during the removal of the same the water and the oil in the lower part of the sampler would of course run out. The sample would then not be a good one. It is best when the rubber cap is pressed down tightly right to the edge of the outer rim of the metallic portion. Then a very tight joint is made and if a small particle of straw, wood, sand or other impurities gets into the ring, a tight joint is made anyway because the rubber is squeezed tightly against the rim of the open end of the sampling tube, and no oil or other substance within the tube can escape as the latter is being drawn out of the tank.

In the place of glass tubes it is also possible to use metallic tube samplers and in this case both ends of the tube are provided with thickened ring portions. The general method of using the tube is the same as in the above and the same precautions must be taken to see that a very tight fit is secured between the lower end of the tube and the closing cap. The use of metallic tubes has however this disadvantage over the glass tubes, namely, in that it is not possible to see how the column of oil looks while in the tube, which also give the analyst an idea of the nature of the layers of oil and impurities in the tank. Furthermore, it is hard to see if the metallic tube is clean enough for taking another sample. On the other hand the metallic tube posesses the advantage of being much easier to handle and to heat up on cold days.

The dimensions of the tube may of course vary considerably in accordance with the ideas of the chemist in the refinery and the size of samples that are required. Suitable dimensions are as follows: one and one-half meters long, twenty millimeters in diameter. The contents will then be approximately 450 cubic centimeters and the weight of the metallic tube will be from 800 to 900 grams.

Pumps Possible

In taking samples of oils from tank cars it has also been suggested that small suction pumps be employed. These consist of a metallic tube into which is fitted a tight fitting piston. But it has been found that these are not suitable for the purpose due to the fact that these pumps suck in the oil that lies immediately in the vicinity of the open end of the tube. Then again when the sampler is allowed to rest on the bottom of the tank while taking a sample, it will be found that the latter will consist entirely of the material that is in that part of the tank car. There is of course some use for these samplers in taking samples of the various layers of the oil in the tank, which would not however give a representative sample of the entire contents of the tank, unless the exact depths of the various layers were known.

It must also be mentioned at this point that it is not proper to take a sample of the oil in a tank directly in the neighborhood of the inlet pipe. For it is a fact that the water that is contained in the oil will settle to the bottom and this is why the water in the tank car for example is allowed to flow out before any weight of the contents is arrived at. Furthermore, the common fallacy that an average sample will be secured by taking a sample of the oil at the top of the tank and another at the bottom and then mixing the two must be emphasized. No really representative sample can be secured in this manner. Of course such a sample may be better than a single sample, if there is no other way in which to secure a better one and it is also true that it is easy to take them. For the sample from the top of the tank car may be taken through the manhole and that at the bottom from the outlet pipe. The arithmetical average of the results obtained on analysis will give some idea as to the composition of the oil in the car.

In figure 3 there is shown a device which is used for making samples of oil from tank cars and shallow tanks, having a maximum depth of three meters. The sampler is nothing more than a board on which a bottle is placed and in which there is a cork which can be pulled out at the proper moment, thus allowing the oil to flow into the bottle. It is not necessary to cork the bottle again before it is drawn out of the oil, for what is in the bottle will stay there and cannot be displaced by the upper layers of oil. A ring holds the neck of the flask firm to the board support.

Deep Tanks Difficult

It is possible in the case of small tanks and the like to use a stirrer for mixing up the contents of the tank before the sample is taken. Irrespective of the question as to how thorough a mixing is secured in this manner, it must be evident that this is a method which is to be preferred by far to the one in which a sample of oil is simply taken at a definite point in the tank. It should of course not be thought that such a mixing is easy to carry out, for the oil is apt to be very viscous and contain much impurities and it requires considerable patience on the part of the sample-taker before a thorough enough mixing is obtained to make it possible to take a good sample.

In taking samples of oil from deep tanks the problem is much more difficult to secure a good average sample. It is not possible to use rigid sampling devices. Plummets are used for this purpose and these are provided with a wire cord or a chain, and by the use of such apparatus it is possible to take samples at different points in the mass of oil.

When sampling thick, highly viscous lubricating oils which also contain a great variety of impurities, it is best to use a wide-mouthed cylinder which has a diameter of at least three inches and which is about 300 millimeters high. For example in taking samples of the oil from different depths in the case of a tank at least ten meters deep it is necessary to start at the top and to take about thirty samples, and each sample should be taken at thirty centimeters intervals in depth, until the bottom is reached. The various samples may then be combined and will yield a very fair representative sample of the entire contents of the tank.

For taking samples of oils of average viscosity a cylinder about one meter high and 1.5 inches in diameter is employed. In the case of a tank ten meters deep it will be necessary to take only ten samples, each one at a point one meter lower down than the one immediately preceding.

An idea of the construction of the sampler which is provided with a plummet at the bottom can be gained from figure 5. The manner of closing the open end of the sampler is indicated. Care must of course be taken in drawing out the sample from the tank and a device consisting of a pulley arrangement for doing this is also shown in figure 4. The double winding arrangement is to provide a means of winding up the cord attached to the stopper on the sampler independently of the cord which is attached to the top part of the sampler itself. In this too tight a pull on the first cord is prevented which might cause the opening of the stopper and the loss of oil from the sampler.

Protecting Doctor from CO_2 Pollution

A brief description of how doctor solution was protected from pollution of CO_2 by the use of a tower between the water wash and the doctor treatment is given here by L. J. Catlin, chief chemist of the Standard Oil Company (Kansas).

"Treating of petroleum distillates in closed systems usually involves several steps, each of which is represented by one or more towers, or tanks, allowing a comparatively quiescent period in the continuous flow, for setting of the treating reagents.

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"In a recent test, in which an extra tower was placed between the water wash and the doctor, where 'spent' doctor was used till completely neutralized, it was found that the resulting product was nearly pure sodium carbonate. The most feasible explanation seems to be that carbon dioxide is released from the wash water by the action of sulphuric acid on bicarbonates, and this carried over with the oil. While not detrimental to the oil, it is obviously detrimental to the doctor, which is usually restored after the lead has been percipitated, and the thought is that it may be neutralized with reagents, which are cheaper than caustic soda, as for instance hydrated lime. At any rate the effectiveness of restored doctor may be increased, as well as its usefulness prolonged, by protecting the caustic from pollution by carbon dioxide by a separate stage of treatment."

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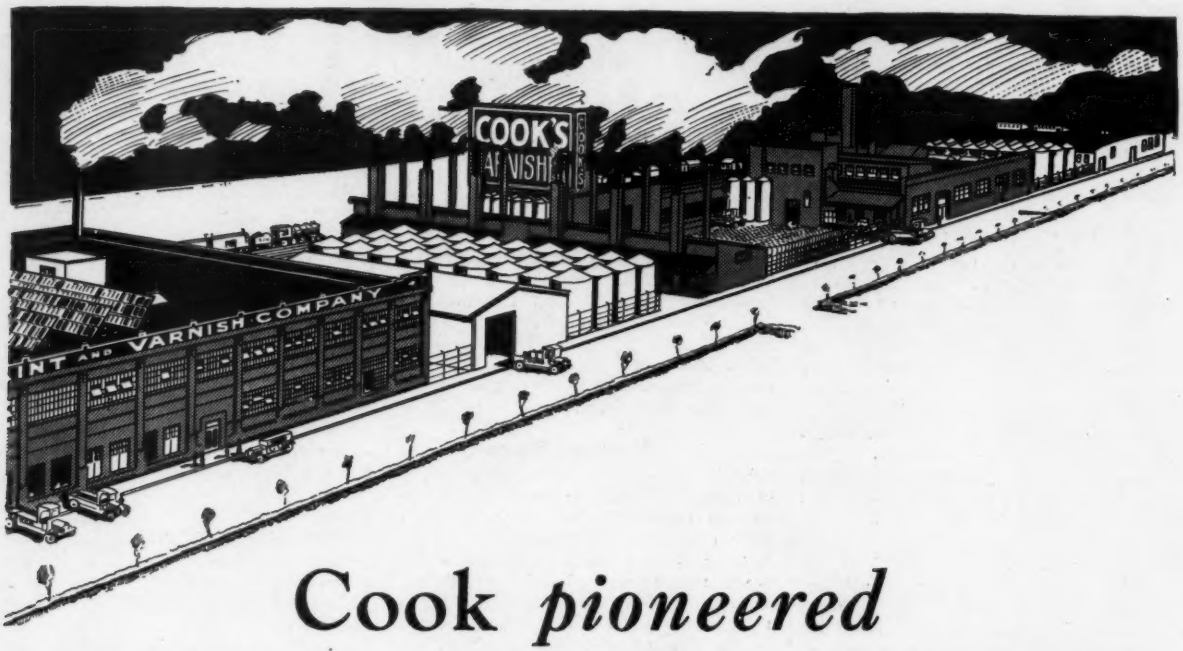

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Proper Design and Operation of Heat Exchangers

By F. L. Kallam, M. E. and A. F. Semino

TWENTY years ago there was no real incentive in the oil industry to recover waste heat. This was partly due to the methods employed and partly to the low cost of fuel. To-day, with the increased fuel costs and the enlarged and improved scope of operation, necessitating greater heat consumption, heat economy has become essential. The industry is, therefore, vitally interested in the design and operation of heat-exchangers.

The following paper is largely from the experiences of the authors with oil-to-oil heat exchangers in California, in connection with gasoline absorption and oil topping plants. While the theory of heat exchange has been widely published and accepted, its application to commercial apparatus has been somewhat neglected. This is probably due to the difficulties of application, inasmuch as commercial equipment is generally not fittted for obtaining all the required data. The method here given was developed because of this lack of information and the need of a solution applicable to commercial apparatus. Even after considerable use and success, it can not be claimed to apply to every case, but it is hoped that it may help to throw some further light upon this particular problem of heat exchange.

The Film Theory of Heat Transfer

It is realized that while there are numerous factors affecting the design of heat-exchangers, they can not be properly handled without a basic understanding of the phenomena of heat transfer itself. It has long been recognized that the heat transfer coefficient, and by the latter we men the B.t.u. transferred per square foot of heating surface per hour per degree Fahrenheit mean temperature difference, depends largely upon the linear velocity of the fluids flowing.

A fluid passing a solid surface flows with relatively free motion in the center of the mass, but the fluid in contact with the surface is much restrained: in fact, it is advantageous to think of it as a practically stationary film. Fluids are very poor heat conductors, so that this non-moving film offers considerable resistance to the passage of heat, the passage depending purely upon conductivity, inasmuch as convection must be disregarded because of the lack of motion within the film itself. Hence film thickness is the controlling factor in heat transmission. The thickness of this film is generally conceded to be indeterminate, but following a defnite law governed by the linear velocity, viscosity and type of flow of the fluid under consideration.

The Resistance Concept

With the above in mind, it is readily seen that in commercial heat exchange apparatus there will be two independent films, one on each side of the separating metallic heating surface, through which the heat must pass, or in other words, two resistances. To these may be added a third, the resistance offered by the metal itself. Heat passing from a hot fluid will be met, first; by the risistance of the film on the metal surface; second, by the metal itself, and third and last, by the film of cold fluid on the opposite side of the separating surface. These resistances are, of course, the reciprocals of the rates of heat passage through the films considered, and these rates are, as we have already stated, the transfer coefficients. To more clearly bring out the point, let us assume an exchanger with hot oil flowing on the exterior of a metal tube and cold oil within. To simplify it, let us assign the following symbols to represent the resistances of the various films:—

R_h=Resistance offered to heat flow in passing through film adhering to the exterior of tube.

R_t=Resistance offered to heat flow in passing through metal tube wall.

R_c=Resistance offered to heat flow in passing through film adhering to inner wall of tube.

Further, let us assign symbols to represent the rates of heat flow through each film as follows:—

k_h=Rate of heat flow through film on exterior of tube.

k_t=Rate of heat flow through metal tube.

k_c=Rate of heat flow through film on interior wall of tube.

Then we may state for the resistance to heat flow through the hot oil film outside the tube:

$$R_h=1/k_h$$

and for the tube wall:

$$R_t=1/k_t$$

and for cold oil film on the inside of the tube:

$$R_c=1/k_c$$

Consider now the passage of heat, at some one point, from the body of the hot oil, through the tube wall, and into the body of the cold oil. Obviously, the resistance to this flow of heat will be the summation of the three individual resistances, giving a total resistance to flow:

$$R=1/k_h+1/k_t+1/k_c$$

Having summed up the film resistances, it is logical to apply the same method in the case of the rate flows. The total rate of heat flow would be:

$$1/k=1/k_h+1/k_t+1/k_c$$

or

$$1/k=R$$

Now assume the following with reference to the temperature of the oils and the tube:

T_a=Temperature of main body of hot oil.

T_b=Temperature of film of hot oil on tube surface.

T_c=Temperature of film of cold oil on tube surface.

T_d=Temperature of main body of cold oil.

Further assume that:

q_h=Total heat transferred through film on outside of tube.

q_t=Total heat transferred through metal tube wall.

q_c=Total heat transferred through film on inside of tube.

q=Total heat transferred from main body of hot oil to main body of cold oil.

If we now assume the area dA and the time dO to be unity, we may write for the heat transferred from the main body of hot oil to the metal surface of the tube:

$$q_h=(T_a-T_b)k_h$$

Likewise, for the heat transferred through the tube wall:

$$q_t=(T_b-T_c)k_t$$

And for the heat passing from the inner wall of the tube to the main body of the cold oil:

NOMENCLATURE

A =Mean effective transfer area—Square feet.
c =Specific heat of fluid—B.t.u. per pound per °F.
c_T =Specific heat of hot fluid—B.t.u. per pound per °F.
c_t =Specific heat of cold fluid—B.t.u. per pound per °F.
C =Coefficient of fluid friction loss depending upon W, D_1 and U.
D_1 =Internal diameter of tube—Inches.
D_2 =Shape factor—Inches.
d =Density of fluid—Pounds per cubic foot.
E =Efficiency of heat transfer—Per cent.
F =Crtical velocity factor depending upon V_s, D_1, S and U.
$J=\frac{W_T c_T}{W_t c_t}$ or $\frac{W_t c_t}{W_T c_T}$ (whichever is less than 1.)
k =Overall coefficient of conductivity.
k_c =Coefficient of conductivity of internal liquid film.
k_H =Coefficient of conductivity of external liquid film.
k_T =Coefficient of conductivity of metallic tube wall.
K =Overall heat transfer coefficient—B.t.u./Hr./Sq. ft./°F.

(Continued on next page.)

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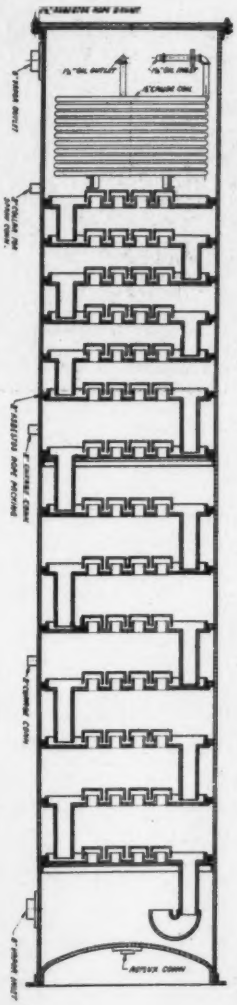

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20	200	352	406	468
30	240	356	408	472
40	251	360	410	476
50	276	362	412	480
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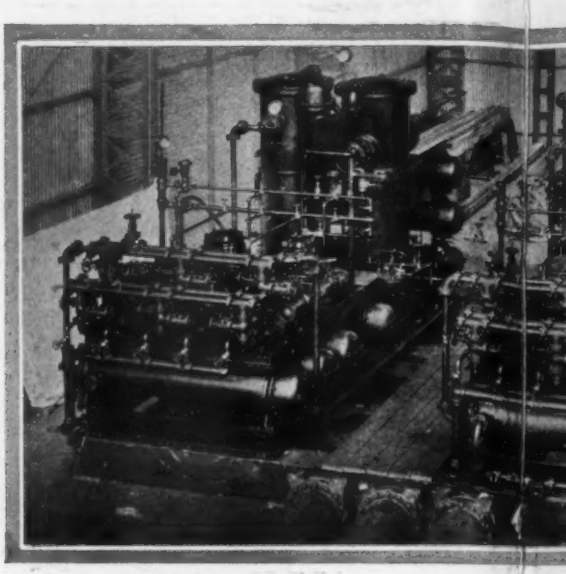

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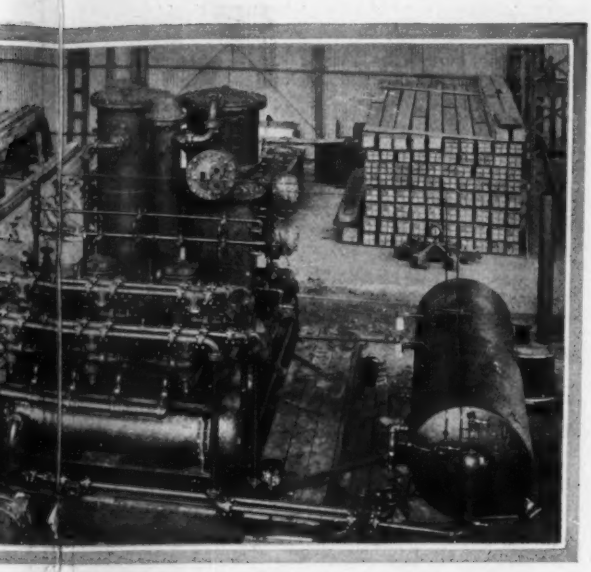

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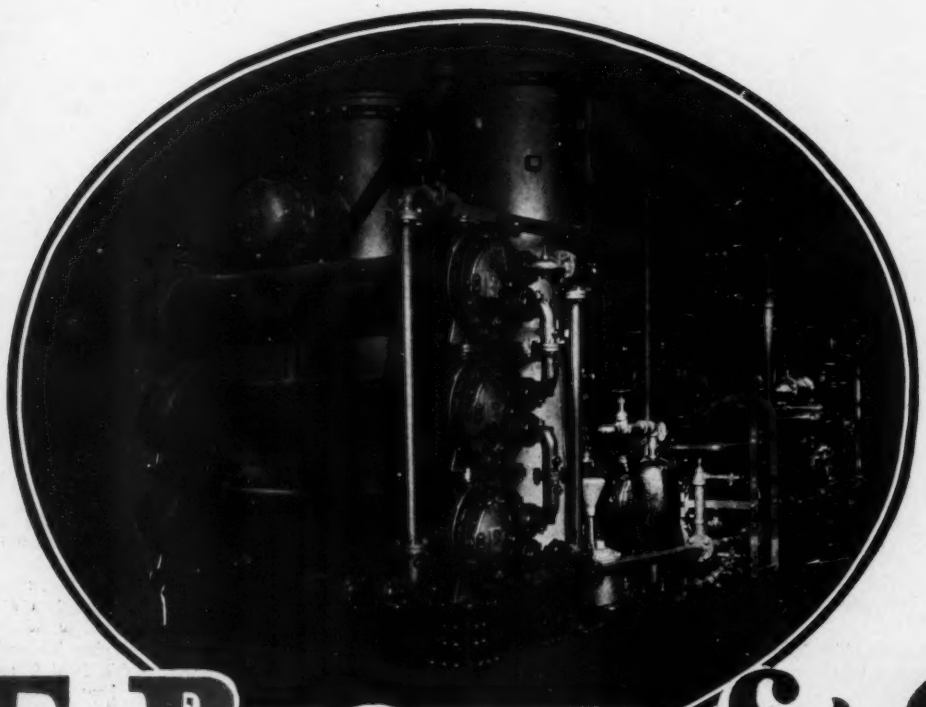

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$q_c=(T_c-T_d)k_c$

Inasmuch as the heat transferred must be equal in each case, the following may be written:

$q=(T_a-T_d)k=(T_a-T_b)k_h=$
$(T_b-T_c)k_t=(T_c-T_d)k_c$

Hence, in commercial practice where intricate film data are not available, we may take the total heat transferred, at any one point, between two bodies of oil separated by a metal surface, to be:

$q=k(T_a-T_b)dA\ dO$

However, the temperatures of the two oils in an exchanger are not the same at all parts of the surface, for one oil is entering hot and leaving cold while the other is entering cold and leaving hot. But in calculating the heat transferred, only one temperature can be used, and that is the logarithmic mean difference of the two oils. The logarithmic mean temperature difference will be denoted by the symbol Ø. Thus the total heat transferred per unit of time in an exchanger is:

$Q=K\text{Ø}A.$

Reviewing what has been said above, it can be seen that a low overall coefficient of heat transfer might be caused by a high resistance in either the films or the tube wall, and in using K this condition could not be detected. However, in commercial work it is quite impossible to determine the thickness of the films, so that for the present, the use of the overall coefficient is more or less forced upon us. In practically all installations it is possible to obtain sufficient data from which the value of K can be calculated.

When selected with judgment, the use of the overall coefficient K gives satisfactory results. Consider the case of the oil-to-oil exchanger: here K is limited to a certain class of equipment, with further limitations in regards to surface arrangement, etc., as will be explained in a later section in this paper. Little, if any, advantage would here be gained by the use of the film coefficients. However, were it necessary to convert an oil-to-oil exchanger into an oil-to-water exchanger, the data at hand would have to be supplemented by further experimental results. With the film coefficients of the oil and water available, together with the conductivity of the metal surface, the determination of k is simple.

Factors Governing Heat Transfer

It is now in order to consider the factors which influence the transfer of heat and which should be kept in mind in designing exchangers.

Type of Flow—Osborne Reynolds, by introducing coloring matter into water flowing through glass tubes, showed that the motion was stream-line or viscous, in character, at low velocities, and eddying or turbulent at high velocities. He found, furthermore, that the change from stream-line to turbulent motion took place suddenly at a definite value of the velocity. This velocity has been termed the "critical velocity", and its value has been found to vary inversely proportional to the diameter of the tube through which the fluid is flowing, and directly proportional to the kinematic viscosity of the fluid.

For geometrically similar pipes, the type of flow will depend upon the diameter of the tube, the velocity of flow, the viscosity and density of the fluid. This may be expressed by the relation:—

$D_iV_aS/U=F$

where D_i=Diameter of tube in inches.
V_a=Velocity of flow in feet per second.
S =Specific gravity of fluid relative to water.
U =Absolute viscosity of fluid in poises.
F =Constant determining type of flow.

This expression may be called the "turbulence factor." This factor has been found to have the same value for all fluids at the point of the critical velocity or transition point. For commercial pipes and under conditions found in practice, the value of F is approximately 25 at the transition point. It follows, therefore, that the turbulence factor may be used as a criterion of the type of flow, for value below 25 the flow is stream-line, above 25, turbulent.

We may go still further and say that when the turbulence factor has the value of 25 there is a sudden and drastic change in the type of flow, but it is not true turbulent flow. The condition existing at this point may be better expressed by the term "unsteady turbulent flow". To further define this condition, it is at this point that a variation in pressure and velocity occurs, but not in a definite and constant ratio. That is to say that an increase in pressure is not accompanied by a corresponding increase in velocity. This unsteady condition of flow has been experimentally determined to exist approximately between 25 and 40 for the value of F. Above 40 we reach a condition of "steady turbulent flow", where an increase in pressure is accompanied by a definite increase in velocity. When this condition prevails, values of pressure and velocity remain constant at any one point over a period of time.

Summing up the three conditions of flow, we have:

For value of D_iV_aS/U less than 25, stream-line flow is encountered. This is a state of viscous flow, telescopic in nature; that is, layers of fluid sliding over other layers. Consequently the roughness of the pipe surface may be neglected, as the flow is really one of liquid to liquid.

For values of D_iV_aS/U between 25 and 40, unsteady turbulent flow is obtained. The state of motion is such that the whirls and eddies take no systematic conformations.

When the value D_iV_aS/U exceeds 40, the flow is in a state of steady turbulent motion, the fluid rolling through the pipe with a vortex motion. With this type of flow, pressures and velocities remain constant at any one point over a period of time.

Three types of flow being possible, the question then arises; which is the most suitable for exchanger practice? Certainly not stream-line, for this is sluggish or telescopic, for here the film next to the tube wall has practically no velocity, while each successive film has a trifle higher velocity than its predecessor. The average velocity will be found to be approximately 0.8 of the maximum, which is at the center of the tube. We may further explain the situation by assuming that approximately 90 per cent of the molecules of the fluids, due to this layer flow, never come in contact with the tube wall. Consequently the heat transferred will depend solely upon the conductivity of the fluid.

Unsteady turbulent flow causes a rolling or turbulent motion within the tube, so that a greater number of molecules come in contact with the tube surface. Consequently two agencies affect the transfer of heat; conduction as in the case of viscous flow, and convection due to the migrating molecules. Thus the turbulent action, which does not permit of a relatively stagnant or thick film next to the tube wall, promotes the transmission of heat.

However, one objection may be raised against this type of flow. It is at this stage of the motion that equal pressure increments do not produce proportional increases in velocity. This factor materially influences the selection of the pumping equipment.

Passing now to steady turbulent flow, it is readily seen that this type of motion possesses all the advantages and none of the disadvantages of the other two types. In fact, several additional advantages may be claimed for it.

It has been previously shown that the velocity affects the film in contact with the transfer surface, the higher the velocity, the thinner the film by reason of the greater attraction between molecules of the fluid at the higher velocities. Since the passage of heat through such a film is governed by the conductivity of the fluid, (the conductivity varying inversely as the film thickness), a thin fluid film is essential for maximum heat transfer. This points directly to steady turbulent flow with its accompanying high veloci-

L =Thickness of fluid film—Feet.
M =Hourly equipment charge per B.t.u.—Dollars.
N =Cost of recovering one B.t.u.—Dollars.
O =Time—Hours.
P =Pressure drop through pipe—Pounds/Sq. in. per foot of length.
q =Total heat transferred from body of hot oil to body of cold oil.
q_c =Total heat transferred through film on inside of tube.
q_H =Total heat transferred through film on outside of tube.
q_T =Total heat transferred through metal tube wall.
Q =Total heat transferred in heat exchanger—B.t.u./Hr./Sq. ft./°F.
R =Total resistance to flow of heat=$R_c+R_H+R_T$.
R_c =Internal liquid film resistance to flow of heat.
R_H =External liquid film resistance to flow of heat.
R_T =Metallic resistance to flow of heat.
s =Viscosity—Saybolt Seconds.
S =Specific gravity of fluid—Water=1.
t_1 =Temperature of fat (cold) oil entering—°F.

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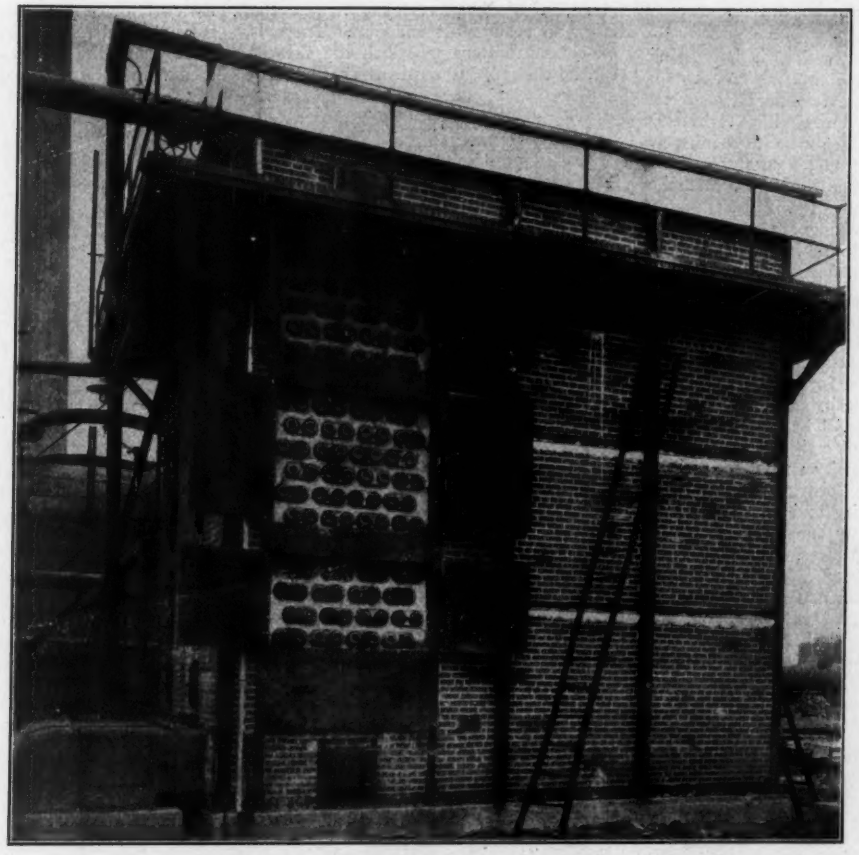

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ties. The fact that a definite relation exists between pressure and velocity makes this type of flow desirable, if for no other reason than the economic advantage.

Steady turbulent flow assures a uniform state of motion, that is, a thorough mixing of the flowing fluid in a regular and periodic way. This mixing of the fluid molecules is not so uniform and complete in the case of unsteady turbulent flow.

Summarizing the advantages for selecting steady turbulent flow for heat transfer design, we find:—

(1) The velocity, being a maximum, guarantees a minimum fluid film thickness.

(2) The motion, being rolling and regular, assures a thorough mixing of the fluid.

(3) The highest velocity is obtainable for any given pressure drop, a decided economic advantage.

In commercial practice, it is possible only to measure the entering and leaving temperatures of the two fluids in an exchanger. Consequently, the turbulence factor for any given condition must be based upon the mean temperature of the fluid. It is possible, however, that this type of flow changes with progressive increments of exchanger area, so that a condition may be found in which the three types of flow exist.

Inasmuch as the temperature change is not proportional to the tube length, (being much greater at the entering portion for a hot fluid being cooled, and greater at the leaving portion for a cold fluid being heated), the viscosity of the fluid will change accordingly. The viscosity in such a case will vary directly as the temperature, while the density varies inversely as the temperature. Consequently the product of the viscosity and density will remain approximately constant for a large range of temperatures. Thus for the same tube, we have D_1V_sS/U changing with the linear dimension of the tube. Therefore to assure steady turbulent flow thruout the entire exchanger, it is necessary that the velocity be such that D_1V_sS/U is equal to or greater than 40 for the maximum value of the viscosity.

The discussion so far concerning turbulent flow, and the advantages to be derived from this in heat transfer, has dealt chiefly with the fluid flowing within the tubes. However, it is just as applicable to the fluid in the shell (the outside of the tubes). It is evident that no exact formula is available for ascertaining the type of flow around the tubes, but it is essential that this flow be turbulent, in order that a high transfer rate from the liquid to the tube surfaces may be obtained.

Turbulence is generally attained in the shell by the use of baffle plates, of countless designs and arrangements, placed at right angles to the exterior of the tubes. This causes the oil in the shell to be thoroughly churned during its passage through the exchanger. There is no known mathematical method for selecting a baffling scheme which will assure maximum turbulence around the outside of the tubes. Continued testing of various forms of baffling arrangements is the only safe method for assuring the maximum transfer. The extent to which the baffling scheme should be carried is governed solely by the pressure drop permissible through the exchanger.

Velocity of Flow:—We have already shown that it is advantageous to operate an exchanger in steady turbulent flow for the highest efficiency; consequently high heat exchange accompanies high velocity. High transfer rates reduce equipment expense, so that high velocity is desirable from an economic standpoint. There is, of course, a limit to which the velocity can be carried, inasmuch as friction drop varies directly as some function of the velocity and hence would have considerable bearing upon the pumping unit.

With any fluid, regardless of viscosity, etc., high velocity tends to limit the thickness of the liquid film. With high rates of flow, there is the element of turbulence which does not permit small liquid particles to adhere to the metallic wall of the transfer surface. However, it is difficult to determine whether velocity or viscosity has the greater influence towards producing film thickness. To make this clear, a condition of low viscosity and low velocity might produce a thinner film than in the case of high viscosity and high velocity. The preferred combination therefore is, low viscosity and high velocity.

Inasmuch as heat transfer is affected by the cleanliness of the transfer surface, any factor promoting cleanliness is desirable. Velocity will produce this effect. It appears that with high velocity, and accompanying turbulence, the bombardment of the transfer surface by the liquid particles has a scrubbing or cleansing effect, which, at the low rates of flow is present in a lesser degree. This action manifests itself by the brightness of the metal surfaces in apparatus operated with high fluid velocities. High flow leaves little opportunity for semi-solid particles to settle out and adhere to the metal surface. In the case of exchangers designed with turbulence or baffle plates in the shell, the results of high velocity is even more striking. Such baffles usually have some form of openings through which the fluid flows, and generally these apertures are at the point of passage of the tubes through the baffle plates. Consequently, at these points, the velocity of flow is very much greater than at other points between plates. Observation will bear out the fact that it is at such points on the exterior of the tubes that the surface is bright and shiny, while at the intermediate points the tube surface will be covered with corrosion and incrustations.

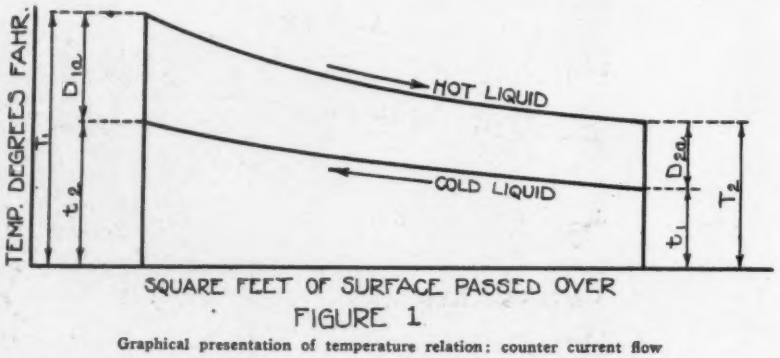

FIGURE 1

Graphical presentation of temperature relation: counter current flow

High velocity also tends to prevent the accumulation of vapors from the fluid into pockets along the metallic walls, such pockets being of course a detriment to the transfer of heat. In handling oils highly saturated with volatile fractions, this is an important item. When an exchanger becomes "gas bound," the heat exchange efficiency suffers appreciably. High velocity tends to minimize this condition by stirring up the oil and so preventing the collection of vapors in large reservoirs.

Relation of Flow—The transmission of heat through metal walls from liquids to liquids is proportional to the difference in temperature between them. However, the temperatures of the substances themselves are not always the same at all parts of a surface: one liquid enters cold and leaves hot, the other enters hot and leaves cold. In calculations, only one temperature can be used and that is the logarithmic mean, and consequently it is necessary to ascertain this temperature difference in each case.

t_2 =Temperature of fat (cold) oil leaving—°F.
T_1 =Temperature of lean (hot) oil entering—°F.
T_2 =Temperature of lean (hot) oil leaving—°F.
T_a =Temperature of body of hot oil.
T_h =Temperature of film of hot oil at tube surface.
T_c =Temperature of film of cold oil at tube surface.
T_d =Temperature of body of cold oil.
$\emptyset$ =Logarithmic mean temperature difference (M.T.D.)—°F.
U =Absolute viscosity of fluid—Poises.
V =Velocity of fluid—Feet per minute.
V_c =Critical velocity of flow—Feet per second.
V_s =Velocity of fluid inside of tube—Feet per second.
W =Weight of fluid flowing inside tube—Pounds per second.
W_t =Weight of cold fluid—Pounds per hour.
W_T =Weight of hot fluid—Pounds per hour.
X =Value of one recovered B.t.u.—Dollars.
Y =Hourly profit from heat exchanger—Dollars.
Z =Kinematic viscosity of fluid—Poises.

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The mean temperature difference is not the arithmetic mean of the least and greatest temperature difference. This is approximately correct only if the least temperature difference is more than half that of the greatest temperature difference. Omitting here the mathematical derivation, Grashoff has shown that the mean temperature difference is the initial temperature difference minus the final temperature difference all divided by the hyperbolic logarithm of ratio of the initial to the final temperature difference.

In the case of the exchanger under discussion, two cases arise, one, in which the fluids flow in opposite direction, or counter-current, and, second, when the two flow in the same direction or in parallel flow. Figure 1 diagrammatically shows the temperature relation for the case of counter-current, the one generally found in practice.

flow is represented in Figure 2.

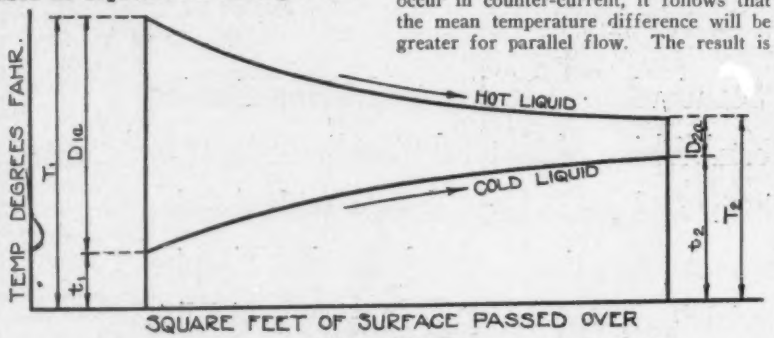

FIGURE 2.
Graphical presentation of temperature re'ation: parallel flow

Here the logarithmic mean temperature difference equals

$$\text{Ø}=\frac{(T_1-t_2)-(T_2-t_1)}{\log_e\frac{(T_1-t_2)}{(T_2-t_1)}}=\frac{D_{1a}-D_{2a}}{\log_e\frac{D_{1a}}{D_{2a}}}$$

where Ø=Logarithmic mean temperature difference.

T_1=Inlet temperature of hot liquid.

T_2=Outlet temperature of hot liquid.

t_1=Inlet temperature of cold liquid.

t_2=Outlet temperature of cold liquid.

$(T_1-t_2)=D_{1a}$=GTD.=Greatest Temperature Diff.

$(T_2-t_1)=D_{2a}$=LTD.=Least Temperature Diff.

The diagrammatical temperature relation for the case of parallel flow is represented in Figure 2.

Here again, the logarithmic mean temperature difference equals,

$$\text{Ø}=\frac{(T_1-t_1)-(T_2-t_2)}{\log_e\frac{(T_1-t_1)}{(T_2-t_2)}}=\frac{D_{1a}-D_{2a}}{\log_e\frac{D_{1a}}{D_{2a}}}$$

It is evident from Figure 1 that for counter-current, the heated liquid may leave at a slightly lower temperature than that of the entering hot liquid, while with parallel flow (Figure 2), the liquid being heated can approach only the temperature at which the hot liquid leaves. Consequently it follows that, other things being equal, parallel flow will require a greater quantity of hot liquid than in the case of counter-current in order to heat the cold liquid to the same degree. Or, in cooling a liquid, a larger amount of cold liquid will be necessary in order to cool the hot liquid through the same range of temperature.

In the case of parallel flow, the greatest temperature difference occurs between the highest temperature of the hot liquid and the lowest temperature of the cold liquid (Figure 2). This is the maximum difference for any condition. The difference between the lowest temperature of the two liquids is naturally much less. The differences in the case of counter-current are always much less than the above maximum. Now, since the maximum temperature difference can never occur in counter-current, it follows that the mean temperature difference will be greater for parallel flow. The result is that less heating surface is required for parallel flow to transfer a given amount of heat. Counter-current apparatus will thus always require a larger surface area than would otherwise be necessary, but does permit attaining higher heat transfer efficiency.

There are cases where it is desirable and economical to use parallel flow; for instance, in the case of a piece of apparatus already built with a definite transfer area. Such an exchanger will transfer more heat units operating with parallel flow because of the greater mean temperature difference, (M. T. D.).

Oftentimes both parallel and counter-flow will be found present in commercial apparatus. This is generally brought about by arranging the flow through the tubes so that the fluid flows from one tube-sheet to the other through several tubes in parallel, returning through a second similar set, each set being designated as a "pass." The same may apply to the flow within the shell, but it is seldom that more than two passes are used. In such a case, the fluid flows through the one-half of the exchanger in one direction and through the other half in the opposite direction. The result of such an arrangement is that in certain parts of the apparatus, parallel flow will be found, while in other parts the flow will be counter-current.

The advantages of such grouping are readily seen. This arrangement permits short tubes and tends toward high velocities. It also facilitates building the exchanger with all the nozzles at one end, this being a great advantage in connecting banks of exchangers together.

To compensate for those portions of the apparatus in parallel flow, it is advisable to increase the velocity of one of the fluids at these points. The tubes lend themselves readily to such purposes, it being required to merely place a smaller number of tubes in the passes where parallel flow exists. The increased velocity tends somewhat to counteract any loss in transfer efficiency because of parallel flow.

In handling oils in an exchanger, two choices are available as to which oil is to flow in the shell and which in the tubes. It is the general practice in absorption plants to gravitate the hot oil from the still through the exchangers into the lean oil tank. The friction drop allowable being small, the hot oil is passed through the shell. However, with pressure distillation, it is optional which of the two oils is circulated through the shell. Here again, in the majority of cases, the hot oil will be found in the shell.

The reasons for the above practice are: (1), force of habit, and (2), insufficient final cooling of the oil. Oftentimes the cooling facilities are greatly overloaded, which makes it desirable to utilize the heat exchanger to the best advantage for cooling the lean oil rather than heating the fat oil. The fat oil may be heated in the pre-heaters. With this idea in mind, the hot oil is passed through the shell to obtain the benefit of radiation from the outer surface of the exchanger.

Exception is taken to these views by the authors who advocate passing the hot oil through the inside of the tubes whenever possible. The amount of heat carried off by a liquid through any part of the cross-section of the tube is proportional to the velocity and temperature of the particles flowing through the given cross-section. Obviously the amount of heat transferred with the hot liquid within the tube will be different from that transferred with cold liquid within the tube, notwithstanding the fact that the same conditions, except the temperature distribution, exist in both cases.

If the products of velocity and temperature in the various parts of a cross-section are obtained and added up, it will be found that the flow that carries the greatest amount of heat through a given cross-section is one in which the maximum tempearture is in the inside of the tube, since in that case the maximum of temperature coincides in locality with the maximum of velocity of flow.

Moreover, with hot oil flowing within the tubes, more heat units are available for entering the cold oil, inasmuch as the radiation losses are less with the cold oil in the shell. The increased transfer rate coupled with the added heat available, will result in the exchange of a greater amount of total heat units.

To Be Continued Next Issue

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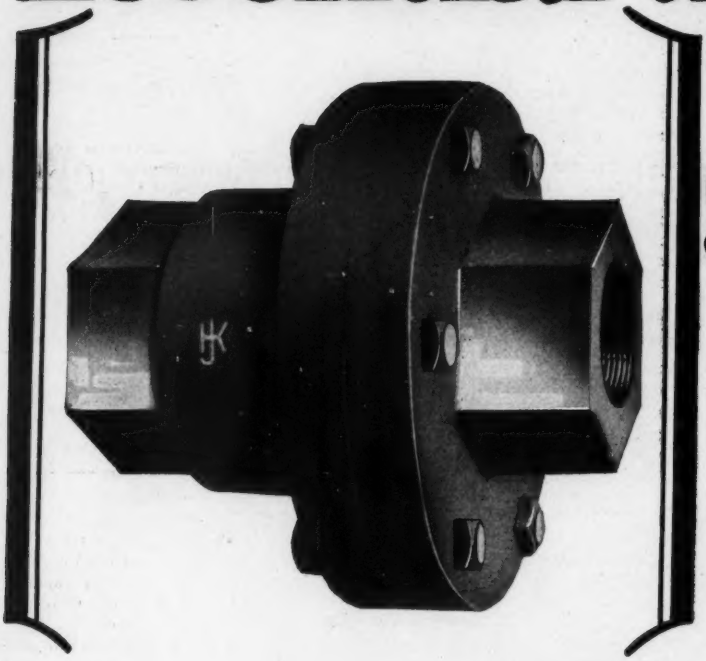

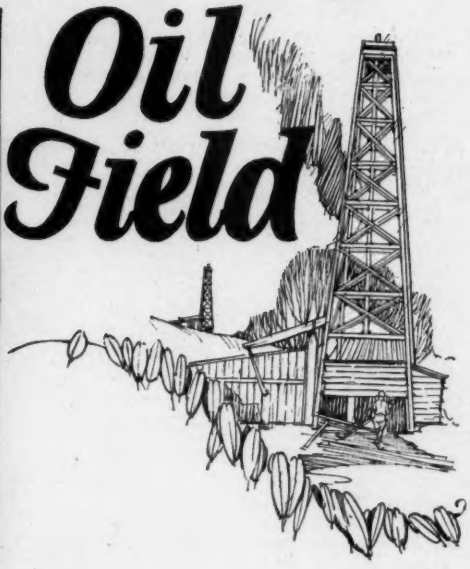

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DEALING IN PERSONALITIES

E. L. Peck

IT was Leland Stanford University that turned E. L. Peck loose on the petroleum industry, with the result that he is now general manager of the natural gasoline department of the Empire Gas & Fuel Company and president of the Association of Natural Gasoline Manufacturers.

Before turning him loose, the noted Pacific Coast school turned him loose numerous times against rival football elevens, with results that never were to the advantage of the rival schools.

Peck liked football so well, he played four years of it after leaving school. Somewhere along the line he acquired the nickname of "Stogie," which still clings with him, especially in the minds of his close friends and business associates.

Incidentally Peck still likes football and would still be at it for an avocation, if the urge to make a living and get ahead did not require efforts along other lines. He thinks well of football but for a real game he confesses that the old Association game requires far more of endurance than anything of the sort played by American rules.

Ukulele, Too

So far as physical condition goes, Peck could today step into football togs and put up a mean game. He possesses a bulky torso built on the wedge type and mounted on a pair of legs that for nimbleness rival the running gear of a lightweight boxer.

And he keep thats way by wrestling with the boys around the Y. M. C. A. in Bartlesville, where the Empire Companies have headquarters and where Peck has a home, where he stays as much as company and association duties will permit. And those daring enough to offer themselves as piece de resistance to Peck's vise-like holds willingly testify to the fact that he is no novice at the grappling game.

And they do say, referring to his neighbors in Bartlesville, that he drags a tantalizing finger across the ukulele strings. It is no uncommon thing for the staid adults of that community and the moonlight lovers as well to catch the strains of Kipling's "To the Ladies," floating out on the evening zephyrs, while Peck provides his own accompaniment on the instrument that made Honolulu, the beach at Waukiki and the shreded wheat skirt famous.

How About It?

So far as is known Peck fared forth from Bartlesville with his ukulele. But the fact of his prowess now being common knowledge, it may be that some coming gathering of gasoline manufacturers will demand an exhibition of strumming on the strings and a rendition a la Peck of the famous lines of "I Learned About Women from Her."

Peck became president of the Association of Natural Gasoline Manufacturers last spring. He did it with very few words, his speech of acceptance being short. Since then, however, he has been running that organization to the satisfaction of all concerned.

Peck is built on the belief that the president of an organization should do more than preside at the regular meetings and deliver an annual address. When there is a meeting of committees in Tulsa or elsewhere, the president is first on the job and he remains there until the work of the gathering has been accomplished.

No man works for E. L. Peck. Many work with him. He's that sort. He has no superiors, no inferiors. He has friends and associates and the longer he lives the more of them he collects.

W. K. Holmes

THE recent transfer of W. K. Holmes from the West Tulsa plant to the Port Arthur refinery by The Texas company recalls that once Holmes could lay claim to the champion job-commutership of the oil industry. He had supervision of the West Tulsa refinery and also the Casper plant for his company.

This double duty was not of long duration. But while it lasted Holmes had upwards of a thousand miles between his two centers of duty. He might leave Tulsa when an ice house job would have been enticing, still his traveling bag would contain some garments of winter time variety, for anyone familiar with summer in Wyoming knows the nights carry a sting.

As for Wyoming winter, Holmes may never have experienced that. But a citizen of Casper once remarked, "the winters would surprise you." Later he admitted a man might freeze to death and not know it, which would seem like a mean surprise.

But getting back to W. K. Holmes, he

had lost his long distance commutership and was superintendent of only the West Tulsa plant, when a promotion early this year required his removal to Port Arthur, where he is now first assistant superintendent in the big plant of the company.

Before he left, employes of the West Tulsa plant presented him with a diamond ring. There was a luncheon and also a banquet in his honor.

The post at West Tulsa has been filled by P. L. Drake, who has been superintendent of the West Dallas plant of The Texas Company.

The Dallas place has been filled by H. P. Parrigan, who was assistant superintendent there.

A. S. Bailey, assistant superintendent of The Texas Company's refinery works at Port Arthur, has been transferred to the Casper, Wyo., refinery of the company as superintendent January 15. Leo F. J. Wilking, acting superintendent at the Casper plant, will go to Port Arthur to take over the superintendency of The Texas Company's asphalt plant, one of the largest in the world, located at Port Neches, near Port Arthur. Extensive construction plans for the Casper refinery toward enlarging it will be supervised by Bailey.

Mr. G. G. Langan, of Tulsa, Oklahoma, District Sales Manager for Hill, Hubbell & Company, of San Francisco, recently left the district headquarters at Tulsa for Houston, where he will remain for a while superintending distribution of the Hill, Hubbell paints.

Firms in Merger

Pittsburgh, Penna.—Merger of the Waverly Oil Works Company with the Pittsburgh Oil & Refining Company has been completed. The concern will be known as the Waverly Oil Works Company. Thomas J. Hilliard is president.

The new Dallas plant of the Ford Motor Company, costing in excess of $1,500,000.00, is one of the largest industrial plants in the Southwest. The self-supporting stack 96″ x 100′ and Boiler Breeching and twenty-six tanks, including 8 96″ x 30′ pressure tanks furnished by this Company were erected and installed ON TIME and passed the rigid inspection of the architect and Insurance Inspectors without a single criticism.

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RECENT REFINERY PATENTS

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the refining industry were granted by the United States Patent Office during February:

No. 1,571,805, granted February 2 to Frank Bernette Samuel, Baton Rouge, La., for a fractionating tower comprising a vertical, insulated, non-heat radiating body portion having depending flues therein, means for directing vapor into the upper ends of said flues, means for collecting condensate from the lower ends of the flues, means for carrying off the resultant vapor in a dry or condensate free state from the lower ends of the flues, means for directing an induced draft of air uniformly upward about said flues for their entire length for cooling and condensing part of the vapor therein, means for preventing loss of heat by radiation through the outer body surface of the tower, and means for varying or maintaining any desired temperature drop within the tower irrespective of weather conditions, or seasonal changes.

No. 1,571,943, granted February 9 to Selden H. Hall, Poughkeepsie, N. Y., and Cyrus Howard Hapgood, Nutley, N. J., assignors to The De Laval Separator Co., New York, for a process of separating wax from mineral oil wax distillates, after the wax distillate solution has been refrigerated to throw out of solution the wax in crystalline form, which comprises subjecting the mixture of oil and wax to centrifugal force, feeding water of a temperature sufficient to melt wax contacting therewith to the periphery of the mass of the mixture undergoing centrifugation, thereby forming a surrounding envelope of water contacting with and adapted to melt the outer layer of wax, separately discharging the oil and the melted wax and water, and heat insulating the inflowing water and the outflowing wax and water from the mixture of wax and oil.

No. 1,571,994, granted February 9 to Harold R. Berry, Brooklyn, N. Y., for a process for the constructive conversion of liquid hydrocarbons of higher boiling points, into liquid hydrocarbons of lower boiling points, simultaneously with the adding of carbon in chemical union with hydrogen to hydrogen-containing gas, which consists in introducing into a confined space hot hydrogen-containing gas, and liquid hydrocarbons, and causing the same to counterflow in intimate contact, so that the liquid hydrocarbons constantly enter increasing temperature, and the hydrogen-containing gas constantly enters reduced temperature, with conditions of heat and pressure so regulated that part of the hydrogen-containing gas combines with the liquid hydrocarbon, and part of the liquid hydrocarbon combines with hydrogen-containing gas, thus decreasing the gravity of the liquid hydrocarbon, and increasing the gravity of the hydrogen-containing gas, and so conditioning the operation that substantially the entire liquid and gaseous materials are withdrawn as a heavier gas and a lighter liquid.

No. 1,572,465, granted February 9 to John C. Black, Destrehan, La., and James W. Weir, Fillmore, Calif., for a method of refining hydrocarbons consisting in treating the hydrocarbons with sulphuric acid; withdrawing the precipitated acid reactions products, adding to the treated hydrocarbons a neutralizing and decolorizing reagent in sufficient quantities to decolorize the hydrocarbons and heating the mixture, then separating the hydrocarbons and admixed reagent.

No. 1,572,584, granted February 9 to James M. Wadsworth, Fort Worth, Texas, assignor to Pierce Petroleum Corporation, New York, for a method of distilling oil characterized by subjecting oil to repeated vaporizing operations, combining fractions of similar boiling point and condensing them to form primary distillates of varying volatility, and continuously redistilling the primary distillates as separate bodies, the residue from the bodies of lighter distillates being added in series to the bodies of heavier distillates.

No. 1,572,626, granted February 9 to Frank Tinker, Sutton Coldfield, England, for an apparatus for the production of gasoline and like motor spirits by distillation processes, consisting of the combination with a fractionating column of a condenser, means for conducting vapor from the fractionating column to the condenser, a collecting tank, means for conducting condensed liquid, gas and vapor from the condenser to the collecting tank, a washer, means for passing vapor and gas from the collecting tank to the washer, a cooler, means for passing condensate from the fractionating column to the cooler, means for conveying cooled condensate from the fractionating column to the cooler, means for conveying cooled condensate from the cooler to the washer, and means for returning liquid from the washer to the fractionating column, substantially as described.

No. 1,572,691, granted February 9 to Adolphe Antoine Francois Marius Seigle, Paris, France, for an apparatus for treating hydrocarbons and the like, comprising a retort having a hollow cylindrical wall, a second hollow cylindrical wall spaced therefrom and concentric therewith, spaced annular transverse partitions between said two walls dividing the space between said walls into a series of annular chambers, a longitudinal partition between said two walls extending throughout the length of said walls, said transverse partitions having apertures situated alternately on opposite sides of said longitudinal partition whereby material to be treated may flow successively through each of said annular chambers in series and in alternately opposite directions, and means for heating the inner wall of said two walls.

No. 1,573,025, granted February 16 to Willard C. Averill, Jr., Houston, Texas, for a petroleum distilling and refining apparatus comprising in combination, a still, a dephlegmator, a vapor line connecting said still with the lower portion of said dephlegmator, a draw-off and water separator connected with the lower end of said dephlegmator, means for withdrawing condensate from said separator and spraying the same into the upper part of said dephlegmator, and means for withdrawing vapor from the upper portion of said dephlegmator.

No. 1,573,129, granted February 16 to John E. Bell, Brooklyn, N. Y., assignor to Sinclair Refining Company, Chicago, for a process for fractional condensation which comprises passing the vapors to be condensed into heat exchange relation with a cooling medium moving through a closed circuit, and regulating the temperature of the medium by replacing a portion thereof with fresh cooling medium.

No. 1,573,167, granted February 16 to Edward W. Isom, Winnetka, Ill., and John E. Bell, Brooklyn, N. Y., assignors to Sinclair Refining Company, Chicago, for an improvement in the condensation of hydrocarbon vapors from pressure stills which comprises circulating a stream of condensate of the vapors through a cooler from and to a relatively large body of the condensate and cooling the circulating condensate and injecting the vapors from the pressure still into this stream between the cooler and the large body of condensate.

No. 1,573,321, granted February 16 to Wadsworth D. Leeper, New York, assignor to American Demulsifying Company, Muskogee, Okla., for a process of demulsifying mineral oils which consists in first washing the oil by passing it through hot water while the oil is in a finely divided state and then passing live steam through the oil thus washed.

No. 1,573,370, granted February 16 to Erwin Blumner, Berlin-Charlottenburg, Germany, for a method of distilling tars and oils which includes the steps of delivering the tars and oils to the lower portion of a column of hot liquid metal and retarding the upward flow through the metal while maintaining the tars and oils in finely subdivided condition, said upward flow of the

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tars and oils effecting an upward circulating of the contiguous liquid metal, and permitting a return or down flow of the metal out of the path of the rising tars and oils.

No. 1,573,389, granted February 16 to Leory G. Gates, Bakersfield, Calif., assignor to Standard Oil Company of Calif., for a process of breaking emulsions, which includes bringing the particles of the emulsion into intimate contact with and separating them from a medium which is both a conductor of static electricity and is adapted to bring both phases of the emulsion to the same electrical charge, and positively removing the charge imparted to said medium.

No. 1,573,532, granted February 16 to Clive Morris Alexander, New York, for a process of decomposing oil, comprising injecting a lighter oil in an atomized liquid form below the surface of a bath of heavy oil, heated to a temperature sufficient to decompose the lighter oil, at such a depth that the lighter oil will be cracked before vaporization, collecting the oil formed as a result of the cracking, leading said heavy oil from the still, removing the carbon thereform and returning it to the still.

No. 1,573,591, granted February 16 to Frank E. Wellman, Kansas City, Kansas, assignor to the Kansas City Gasoline Company, Kansas City, Kansas, for a process of heating fluids and the like which consists in first heating a mass of granular refractory material and then flowing the same over and about the body of fluid to be heated and out of contact therewith.

No. 1,574,011, granted February 23 to John H. Wiggins, Bartlesville, Oklahoma, for a floating deck for liquid storage tanks, comprising a portion that floats upon the liquid in the tank and covers the major part of the surface of the liquid, pontoons or buoyant devices removably mounted in openings in said portion arranged adjacent the outer edge of same, and means for preventing the liquid in the tank from escaping upwardly through one of said openings when the portion that cooperates with said opening is removed.

No. 1,574,012, granted February 23 to John H. Wiggins, Bartlesville, Oklahoma, for a liquid storage tank provided with a side wall formed by a vertically-disposed, cylindrical member open at its upper end, a vertically-disposed mast or upright at the center of the tank, devices projecting upwardly above the top edge of said side wall, radially-disposed tension member connected at their inner ends to said mast and at their outer ends to said devices, and a floating deck supported by the liquid in the tank and provided with a shoe whose upper edge portion slides upon said upwardly-projecting devices under certain conditions.

No. 1,574,013, granted February 23 to John H. Wiggins, Bartlesville, Oklahoma, for a floating deck for liquid storage tanks, comprising a cenrtal body portion that normally floats upon the liquid in the tank, shoe members arranged in sliding engagement with the side wall of the tank with their lower edge portions submerged in the liquid in the tank, and a supporting means for said shoe members carried by the central body portion of the deck and so constructed and arranged that gravity tends to hold said shoe members in parallel relationship with the side wall of the tank and in snug engagement with said side wall.

No. 1,574,507, granted February 23 to George Grover Oberfell, Albert M. Ballard, Richard C. Alden, Edward L. Utsinger, and William R. Lentz, Tulsa, Oklahoma, assignors to Chestnut and Smith Corporation, Tulsa, for a process of treating natural gas gasoline, which consists in dissolving therein a quantity of elementary sulphur, and then passing the gasoline through a solution of sodium hydroxide without distilling the gasoline.

No. 1,574,547, granted February 23 to John E. Bell, Brooklyn, N. Y., assignor to Sinclair Refining Co., Chicago, for an improvement in the heating of oil cracking stills in which oil is heated to the cracking temperature by hot products of combustion from a furnace passing externally over the oil heating surfaces of the still, which comprises recycling over the oil heating surfaces in admixture with fresh products of combustion from the furnace a portion of the hot waste heating gases which have previously passed over the heating surfaces.

No. 1,574,622, granted February 23, to Louis Granger, Charles Mariller and Charles Prache, Paris, France, for a method of distilling crude mineral oil consisting in vaporizing the oil, condensing the vapors in evaporation with rapid circulation of water to ensure operation with small temperature drop, vaporizing water in said evaporators by absorbing the latent heat of the condensed products to produce steam at a temperature only slightly less than the condensed vapors and at a high pressure and using said steam in the heating of said oil and for the production of power.

To Increase Capacity

The Magnolia Petroleum Company will double its gasoline plant capacity at Wewoka, Okla. It is reported that instead of adding to the present plant, another of the same size or slightly larger capacity will be constructed near the present plant.

The present plant, although running at capacity, has not been able to meet the demands made upon it.

Building Newton Plant

Tulsa, Oklahoma.—The Pure Oil Company is installing a natural gasoline plant of the Newton type in the Meehan field near Cushing.

Arthur J. L. Hutchinson, research engineer with the Pacific Gasoline Corporation, recently was elected a member of Sigma Xi, a national scientific research society. The election came through the California Institute of Technology chapter. Mr. Hutchinson, who is well known among Pacific coast gasoline engineers, is a graduate of Stanford University, where he took a prominent part in activities of the Phi Lamda Upsilon fraternity, an honorary chemical organization.

S. A. Montgomery has been named assistant superintendent of the Wood River refinery of the Standard Oil Company (Indiana.) This promotion follows a number of steps up the ladder, for Montgomery went to the Wood River plant in 1919, having analytical and reasearch work in the laboratory. It was two years later that he was transferred to the paraffine works as assistant superintendent of that department. When a white oil plant was built in 1924, Montgomery assumed that duty. A year later his duties were expanded to the lubricating works and pitch department and the chemical laboratory was placed under his direction. Now as assistant superintendent his field activity has been extended to include the whole plant.

R. B. Werey, formerly assistant engineer at the Bartlesville, Oklahoma, station of the Bureau of Mines, has resigned to become assistant superintendent of the Argentine government refinery at La Plata, near Buenos Aires, which was recently completed by the Bethlehem Steel Company. He sailed from New York February 27, accompanied by his wife.

MIDWEST Piping

Midwest Piping is fabricated to satisfy the pressure, temperature, space and other requirements of piping for the various processes used in individual refineries and natural gasoline manufacturing plants.

Ask for circular O-1

MIDWEST PIPING & SUPPLY COMPANY
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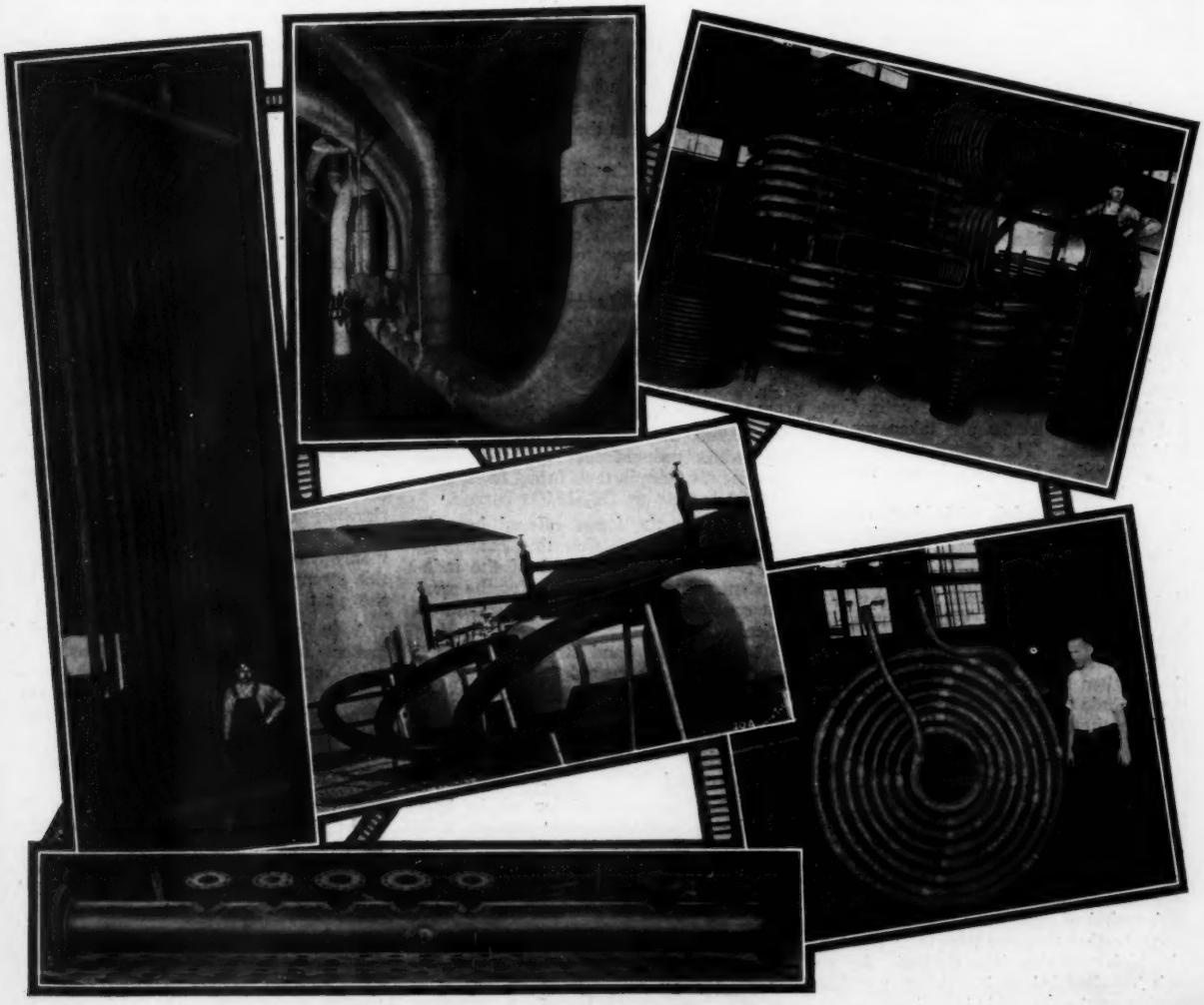


Mention Where You Saw the Advertisement

Lowered Stocks Partly Responsible For Mid-Continent Crude Strength

By Grady Triplett

IT HAS become a habit to point an accusing finger at the independent refiner when the Mid-Continent crude oil market shows strength. Unwarranted premium paying is charged with raising crude oil prices prematurely for the past three years, resulting in excessive gasoline production and a weak market on both crude oil and gasoline.

Present strength of the Mid-Continent crude oil market is popularly attributed to this zeal of premium paying. It is accepted as fact that no economic reason exists for higher prices and premiums on Mid-Continent crude oils.

Yet the statistics of 1925, compiled by the Bureau of Mines shows the period to have been one in which stocks of crude oil at Mid-Continent refineries and stocks of Mid-Continent crude oil other than at refineries were reduced materially. And the figures are offered here in proof of a contention that there is some economic ground for the present tendency of crude oil prices.

Stocks Down—Output Up

Furthermore, reduction of Mid-Continent crude oil stocks came despite a greater crude oil production for that area in 1925. Crude oil stocks were reduced 25,000,000 barrels in the Mid-Continent during a year when well output was 18,000,000 barrels in excess of the previous year.

Use of the several columns of figures herewith is somewhat inaccurate for comparative purposes, due to there being no fixed boundaries for the Mid-Continent area. For stocks other than those at refineries, Oklahoma, Kansas, North, Central and West Texas are taken as the Mid-Continent. The figures too refer to oil produced in this area, irrespective of where it may be stored.

In the case of crude oil held at refineries, Oklahoma and Kansas are identical with the territory of the paragraph above but "Texas inland" is the term used for that state. While this will include all of North, Central and West Texas, it doubtless includes more.

Production figures for Texas are for those other than the Gulf Coast, which may include territory not belonging to the Mid-Continent.

All Wanted Crude

It is doubtful if these possible differences of territory can have any bearing on any economic tendencies that have brought about a stronger crude oil market in the Mid-Continent with one price advance already recorded.

A recital of events of the past year may serve further to prove the contention that the higher market is not wholly the result of frenzied and reckless premium paying on the part of independent refiners.

Crude oil prices weakened last summer and finally there was a reduction in posted prices. But even then the several buyers and transporters of crude oil must have been drawing on stocks. Early in the fall it was admitted that only the Prairie Pipe Line Company and the Ozark Pipe Line Company (Roxana) were adding to storage. Other buyers at the time were soliciting connections. While no premiums were offered, producers began to talk of premiums, because they knew of the efforts of the bigger buyers to gain connections.

It is not so easy to learn what the smaller refining concerns are doing. No doubt some of these were active in the fields. At any rate the crude oil market carried unmistakable strength last fall and it continued into the winter. By the time the price increase of 25 cents was posted February 1, a dozen concerns were known to be in the field with premiums.

Such efforts were promptly branded as foolhardy. The independent refiner was again termed the individual, who forced the price of crude oil up in the winter, which in turn forces the price of gasoline down in the summer.

Yet the zeal with which all classes of crude oil buyers went after connections in the fall and winter left no doubt that the man expecting to have connections in the summer, would have to get them in the winter.

What Figures Show

As for stored oil, Mid-Continent refiners last year reduced their crude oil supply from 6,768,000 barrels to 4,366,000 barrels.

While the demands of independent refiners and the shipments by pipe lines and water reduced the supply of Mid-Continent crudes in tank farms from 176,754,000 barrels to 153,513,000 barrels.

These are the items offered here in proof or the contention that something more than the unwise zeal of the independent refiner is responsible for the present condition of Mid-Continent crude oil prices.

On the other hand stocks of finished products were increased during the year. It is not the purpose here to take up the position of the supply of gasoline. It has some bearing on crude oil prices over a brief period, while over a cycle it may control the price of crude oil.

But the present condition of the Mid-Continent crude oil market appears to be one properly described as "local." It has been made by activity on the part of buyers. Whether it will later run afoul of unsold gasoline is another matter.

Draft on Mid-Continent crude oil from tank farms was uniform last year. The period opened with 176,754,000 barrels in tanks. Each month showed a reduction. The reduction came so near to 24,000,000 barrels that the uniformity of it looks like 2,000,000 barrels were taken out each month.

Under that condition it does not seem surprising that buying and transporting concerns had men in the fields last fall seeking connections. Oil was at medium price then and stocks are being depleted. The situation presents itself as one when the buying of more oil was wise.

The Picture

Refiners did not deplete their stocks with the uniformity of withdrawals from tank farms. The monthly record on refinery stocks shows additions in April, May, June and July. The last two of these months should have witnessed withdrawals.

Reductions began in August and continued to the end of the year. It is significant that the stock reductions at the end of the year came when pipe line concerns were seeking connections.

So these are the facts Mid-Continent refiners faced at the end of 1925 and the beginning of 1926. Tank farm supplies of Mid-Continent oils were being reduced, despite higher output from wells; refinery crude oil stocks were undergoing reduction; while producers were being courted for connections.

It is not improbable that undue zeal played some part in the way premium paying came into the Mid-Continent crude oil market during December and January. But to charge it wholly to rashness, seems to ignore facts that are borne out in figures of unquestioned standing.

Only the Mid-Continent area is considered in this article, for the reason that the crude oil market for this area is showing more strength than any other and for the further reason that it is commonly accepted that the only reason for this strength is a display of rashness on the part of independent refiners.

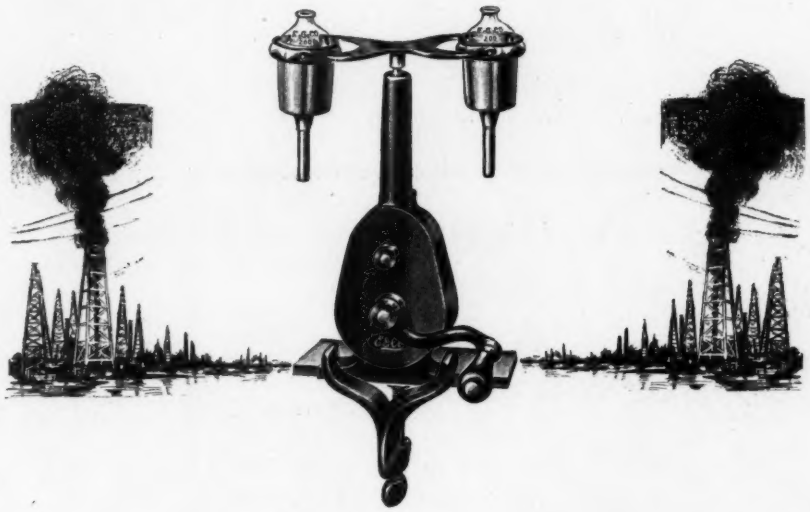
A further common remark is that the present tendency will bring disaster to Mid-Continent refiners later in the year, as has been the case during the past three years. Only time will tell that. Still indications point that way.

What of Summer?

Fundamentally it is impossible for one area of the refining industry to enjoy higher prices than other regions, unless the market for products is restricted. The Mid-Continent market is not restricted, for gasoline from Oklahoma sells as far east as Pennsylvania.

Certainly the Mid-Continent refiner must look on refiners of every other section as competitors. The way California

Do You Need A Centrifuge?



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General Description—For operation by hand, can be clamped to table. 80 revolutions of handle produce 1600 revolutions of arm. Release of handle prevents stoppage and consequent disturbance of sediment. Fitted with bronze gears and Tobin bronze pinion.

NUMBER	SPECIFICATIONS	PRICE (*Prices subject to discount in quantity*)
B610	15cc, 2 arm complete with shields and two tubes	$10.00 ea.
B612	15cc, 4 arm complete with shields and four tubes	12.00 "
B613	50cc, 2 arm complete with shields and two tubes	13.50 "
O108	Oil Centrifuge-Goetz form, 50cc, complete with holders and two tubes	15.00 "
O109	Oil Centrifuge-Goetz form, 100cc, complete with holders and two tubes	18.00 "

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B610	$.25 each less 10% in gross lots
B613	.40 each less 10% in gross lots
O108	.95 each less 10% in gross lots
O109	.95 each less 10% in gross lots

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gasoline was sold in Eastern Ohio last summer is evidence of how one part of the country can take advantage of favorable conditions in another part, so far as refining is concerned.

It may be that the Mid-Continent refiner has not been thinking of next summer and California gasoline. In striving to bar rats from his chicken coop, a farmer may fail to notice the chance for wolves in his calf pasture. The rat menace is sufficient for the time.

Likewise the Mid-Continent refiner has had something at home to claim his attention. Crude oil has been a coveted commodity for some six months. He has had to use his best inducements to be assured of raw material for the year. The premium is his best inducement.

But over all of this is the fact that figures for the year 1925 reveal sound reasons for the activity on the part of both major concerns and independent refiners to get crude oil supplies.

Crude Oil Stocks at Mid-Continent Refineries during 1925:

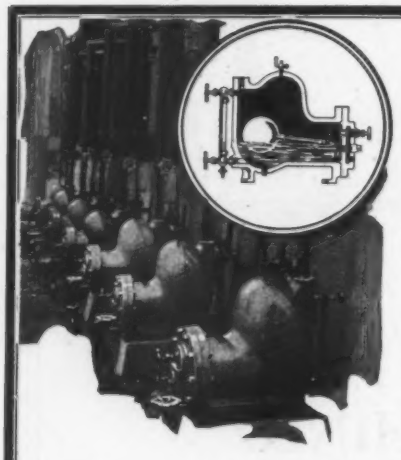
	Barrels
Dec . 31, 1925	6,768,000
Jan. 31, 1925	6,645,000
Feb. 28, 1925	7,183,000
March 31, 1925	6,072,000
April 30, 1925	6,150,000
May 31, 1925	6,114,000
June 30, 1925	6,542,000
July 31, 1925	6,579,000
Aug. 31, 1925	5,827,000
Sept. 30, 1925	5,553,000
Oct. 31, 1925	4,777,000
Nov. 30, 1925	4,694,000
Dec. 31, 1925	4,366,000
Reduction during year	2,402,000

Mid-Continent crude oil storage for 1925, other than refineries:

Dec. 31, 1924	176,754,000
Jan. 31, 1925	174,412,000
Feb. 28, 1925	173,510,000
Mar. 31, 1925	172,937,000
April 30, 1925	171,565,000
May 31, 1925	170,911,000
June 30, 1925	166,204,000
July 31, 1925	163,348,000
Aug. 31, 1925	161,627,000
Sept. 30, 1925	159,346,000
Oct. 31, 1925	159,108,000
Nov. 30, 1925	158,124,000
Dec. 31, 1925	153,513,000
Reduction during year	23,241,000

Mid-Continent production compared for 1924 and 1925, figures from Bureau of Mines annual report:

	Oklahoma	Texas outside Gulf Coast	Kansas	Total
1924—	173,538,000	108,440,000	28,836,000	310,814,000
1925—	176,760,000	114,269,000	38,248,000	329,277,000
Increase 1925—	3,222,000	5,829,000	9,412,000	18,463,000



Trap Your Gasoline

Illustration shows American Ideal Traps in the Absorption Tower of the natural gasoline plant of Palmer Corporation, Schwartz, La. These traps are used to trap gasoline from the absorber and to catch the residue gas passing back to absorber, where it is again picked up by the mineral seal spray and the gasoline absorbed by same.

AMERICAN IDEAL STEAM TRAP

has an unusually large valve opening, consequently you can use a smaller, therefore a less expensive American Ideal Trap and handle the same volume.

This extra large valve orifice makes it impossible for the valve to clog or chatter. Seat can be removed without making disconnections.

Is equipped with an extra heavy seamless copper float of exceptionally large diameter, which is guaranteed for the life of the trap.

Other features explained in our interesting booklet. Write for Booklet S-16.

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1850 1925 75th Anniversary

Pipe Company Manager

The Midwest Piping and Supply Company, of St. Louis, Missouri, announces the appointment of C. S. Simon to manage its Tulsa office. This office has been moved to 805 Mayo Building.

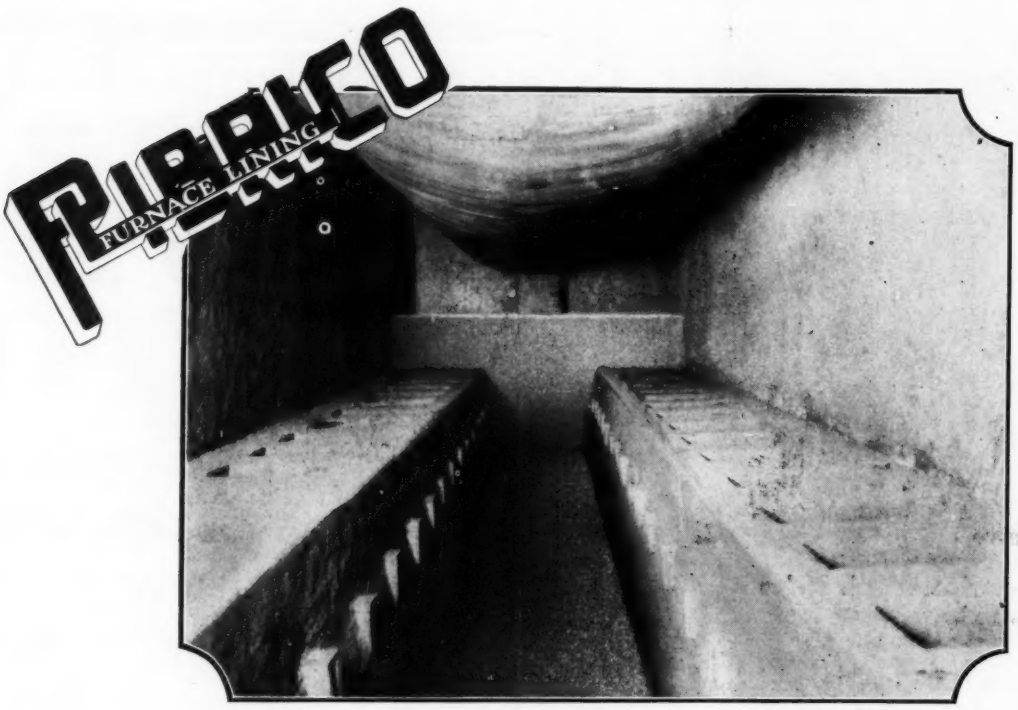
Mr. Simon is a practical oil man and is well qualified to aid the refiners and natural gasoline manufacturers with their piping problems. For the past two and one-half years he has been employed as master mechanic at the Wood River Refinery of the Roxana Petroleum Corporation.

Ventilating Equipment

"A B C" Pressure Blowers and Exhausters are described in bulletin No. 1608, published by the American Blower Company, Detroit, Michigan. These blowers and exhausters are recommended for use wherever special ventilating equipment is necessary. Copies of the bulletin will be mailed on application.

Simms to Build Plant In Smackover Field

Dallas, Texas.—The Simms Oil Company, which is a comparatively new entrant into the refinery and natural gasoline branch of the oil industry, is to erect a refinery and natural gasoline plant in the Smackover, Arkansas field, where both gas and crude production is owned by the company. A cracking plant that will handle about 2500 barrels of crude daily will be erected, while an absorption plant will be located in the Smackover field proper.



The Plibrico Diffusing Furnace cuts still maintenance cost

WITH this dog-house type furnace, the life of the still is greatly increased. The flame is confined to the "dog-house" combustion chamber. The still is heated by radiation from the refractory. Direct impingement of the flame on the still bottom or tubes is eliminated.

Even diffusion of the heat from the combustion chamber prevents the bottom overheating at any one point, giving longer still life, and closer still temperature control.

This construction, in addition, increases efficiency and fuel economy; the high temperature zone in the "dog-house" combustion chamber gives complete combustion of the oil.

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A battery of oil stills equipped with the Plibrico Diffusing Furnace

Plibrico Furnace Lining, the refractory that outlasts fire-brick two to four times, is the only refractory used in the construction of the Plibrico Diffusing Furnace

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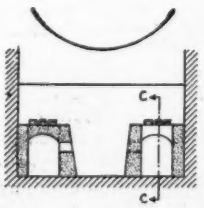
Factories: Chicago and Trenton, N. J.



Cross-section of a Plibrico Diffusing Furnace

Send the Plibrico engineer (there are engineers in 85 cities) to tell me about the Plibrico Duffusing Furnace.

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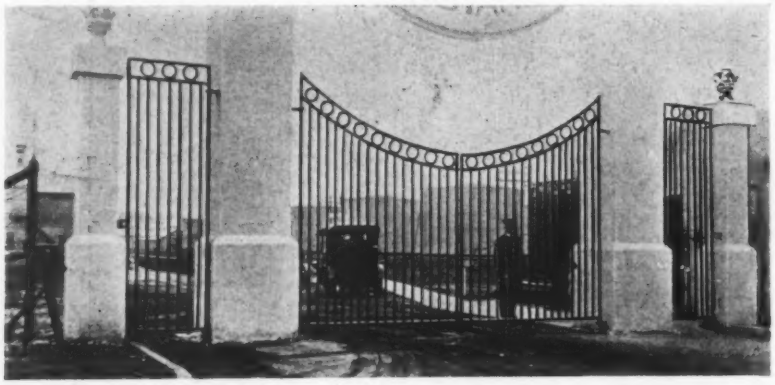

Oxy-Acetylene Torch Helps Utilize Much Waste Material

Among the important results of industrialism has been the discovery of new and valuable uses for common materials. Appliances to utilize waste or scrap materials evolve so rapidly that what was scrap until yesterday has today become some important product.

The oxy-acetylene process has rendered valuable untold miles of scrap pipe for instance. In the back yard of many industrial plants is a junk pile and, unsightly as it is, under the flame it becomes the scene of miracles. Ordinarily there are hundreds of feet of pipe in varying sizes and lengths lying around. If needed, more can be obtained at a low price from a scrap dealer.

One large plant recently had need of a strong yet not ungainly fence, with an impressive gateway. They had an ingenious man who saw the connection between a nearby junk pile, the oxy-acetylene blowpipe and the company's need. Sketches were made and work started.

The first step consisted of providing pipe of correct diameter to proper length. This was readily done with the cutting blowpipe. It proved a simple matter to weld short pieces together. When a good supply of usable lengths was on hand, assembling began.

The fence was a simple affair. It was made with all joints welded, as shown in Fig. 1. Heavy wire netting was used for fence covering between posts. The apparent difficulty of attaching this to the posts was easily overcome by use of the cutting blowpipe; U-shaped cuts like those shown in Fig. 2, were made in each post and the tongue formed was bent inward over strands of heavy wire. The method insures strength and durability.

An attractive gateway was especially desirable so a little more time and thought were spent in its construction. Fig. 3 shows the artistic results. Carefully graded lengths of pipe were welded to a straight supporting cross-beam of heavier pipe; two bent pipe lengths rounded off the top of each large gate. These graceful bends were made after heating the pipe with an oxy-acetylene flame. Then cross sections of large diameter pipe were cut with the blowpipe, and these, welded at intervals along the top of the gates, added greatly to their appearance.

Using the same general methods, smaller sidewalk gates were made. Concrete gate posts 3½ feet square gave an imposing appearance to the entrance.

The entire cost of erection was slight and a valuable property item has arisen, from a scrap pile.

Mettler Announces Distributor

Los Angeles, California.—The Lee B. Mettler Company, 406 S. Main Street, Los Angeles, California, manufacturers of Mettler Entrained Combustion Gas Burners, announces the appointment of The Daly Company, 1425 Sixteenth Street, Denver, Colorado, as distributors of its burner in the Rocky Mountain District. This territory includes Wyoming, Colorado, and New Mexico.

Laboratory Equipment Catalog

The Fort Worth Laboratories, Instrument Department, 828½ Monroe Street, Fort Worth, Texas, has ready for distribution a new illustrated laboratory and instrument catalog, No. 1800. This catalog will be of especial interest to oil refineries and gasoline plants. Copies will be mailed on request.

Drive Turbine Bulletir

Type D-54, mechanical drive turbine, intended for the driving of centrifugal pumps, blowers and other classes of mechanical drive, is described in Bulletin GEA-197, just released by the General Electric Company, Schenectady, New York. Copies will be mailed upon request to the company.

Recording Instrument Catalog

The Brown Instrument Company, Philadelphia, Pennsylvania, has put out a new catalog on Brown Automatic Temperature Control Instruments. These include indicating, signalling, recording and alarm instruments, all of which find a ready application in the refining industry. Copies of the catalog may be obtained by asking for catalog No. 87.

New Type Bubble Tower Developed by Engineers

Winkler and Koch, Consulting Engineers, of Wichita, Kansas, have developed and placed on the market a bubble tower which gives the closest possible cuts in one operation, eliminates rerunning, is independent of atmospheric conditions, operates on a smaller fuel consumption, and most important of all, results in materially increased yields of gasoline.

They have equipped a number of cracking plants with these towers to produce end point gasoline direct in one operation, as well as a large number of crude, rerun, and pipe still arrangements.

Texas Fire Brick

—a high quality fire brick now serving Southwestern Refiners who once thought more costly brick necessary to their needs.

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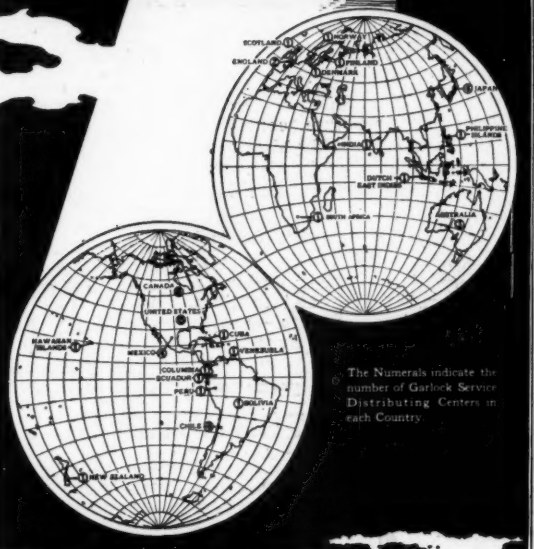

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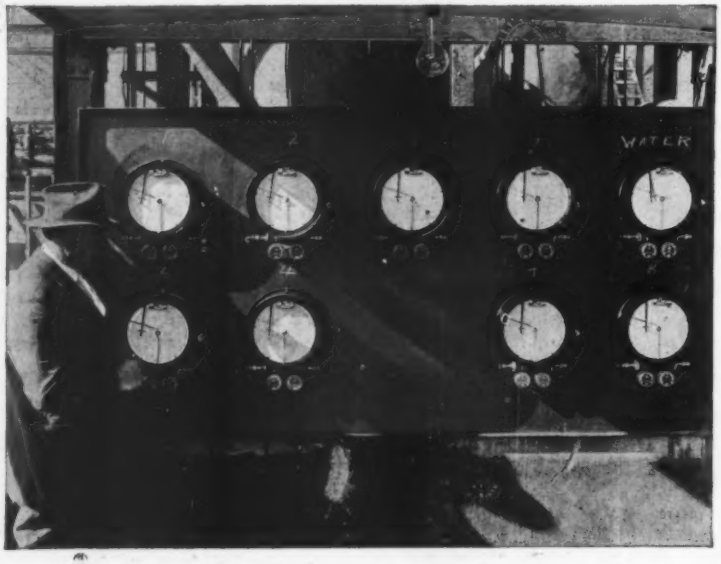
The Standard Packing of the World



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This instrument is permanently accurate within less than one per cent of total scale range. You will get the same fine cut fraction tomorrow and the next day as you do today. We can refer you to hundreds of these installations.

Foxboro instruments are backed by a national service organization with headquarters at Tulsa, Pittsburgh, Los Angeles, San Francisco and Foxboro. Instrument users located within 200 miles of these points are now getting 24 hour service.

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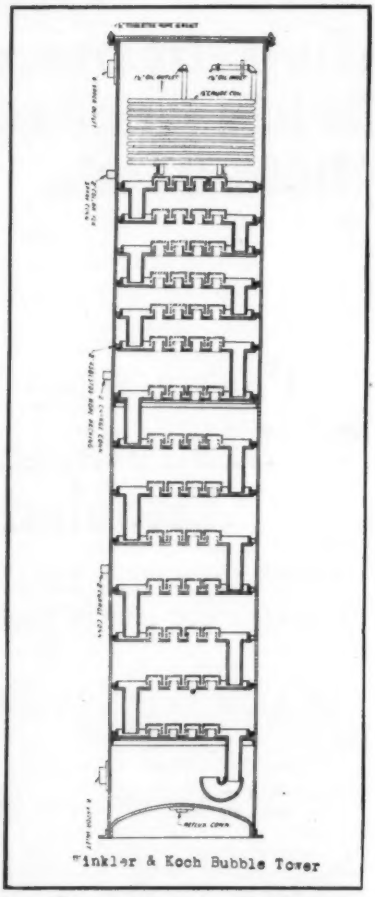
When an ordinary shell still crude battery is equipped with these towers they will produce streams like the following:

Stream	No. 1	No. 2	No. 3	No. 4
	Degrees F.			
1	100	326	390	440
10	164	350	404	462
20	200	352	406	468
30	240	356	408	472
40	261	360	410	476
50	276	362	412	480
60	290	364	414	484
70	301	367	416	488
80	312	372	418	496
90	320	376	424	501
EP	324	385	434	518

It will be noticed that each stream is "gapped" from the preceding stream which is the earmark of close fractionation.

The bubble decks are of solid cast iron one-half inch thick which eliminates leakage and due to the thickness of the cast iron can resist corrosion for a long time.

In a number of cases the refiners' existing tower shells have been equipped with these decks. The decks can be installed and removed in a very short time which greatly facilitates cleaning them, should they ever become dirty.



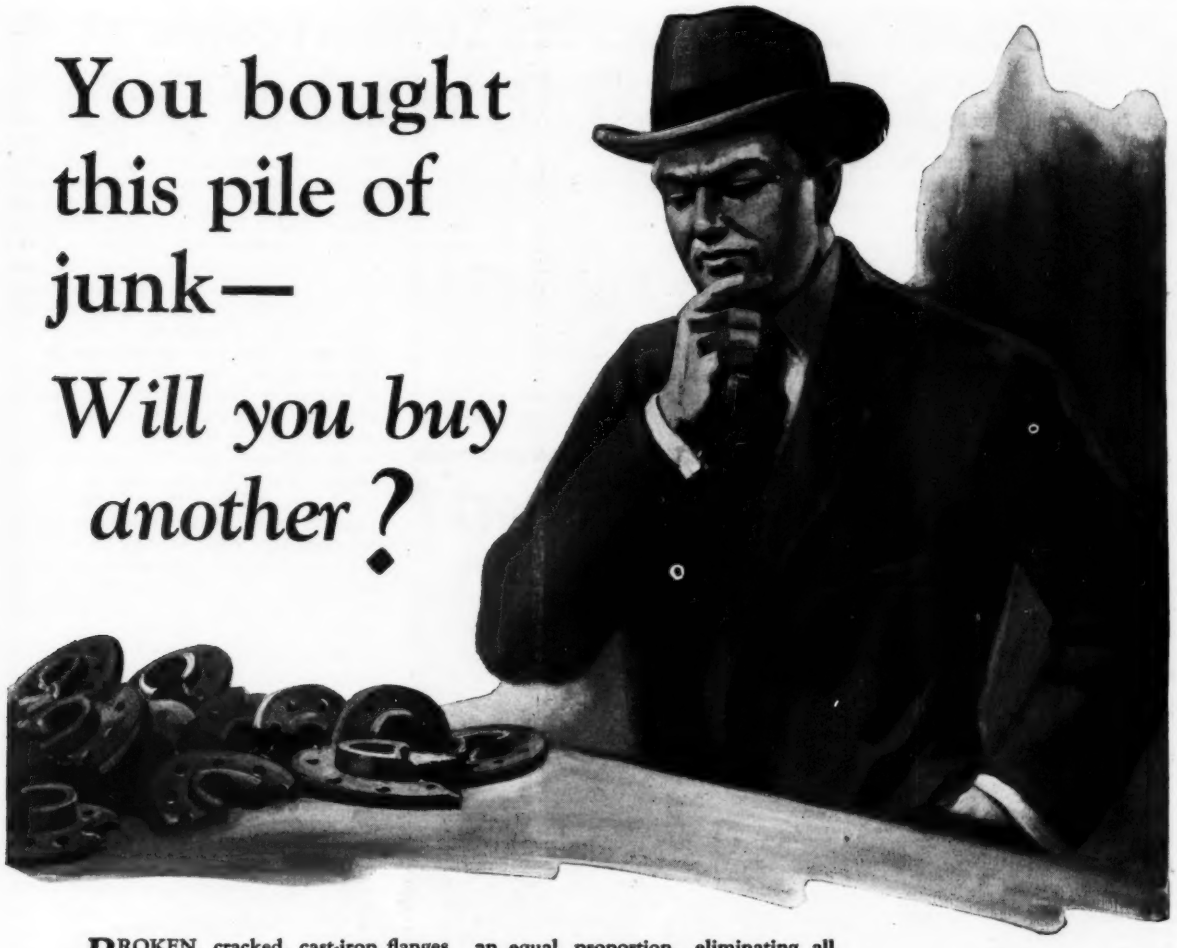
Winkler & Koch Bubble Tower

Wilson-Snyder Folder

A folder on the long stroke Wilson-Snyder Oil Pump has been issued by the Wilson - Snyder Manufacturing Company, Pittsburgh, Pennsylvania. Copies of the folder will be sent to any one on request to the company.

You bought this pile of junk—

Will you buy another?



BROKEN, cracked, cast-iron flanges—all useless. And you paid good money for them! Many broken in installation, others cracked by expansion, contraction, vibration or other movements in the pipe line. Will you take another chance?

The engineering trend is toward forged steel flanges everywhere!

Pennsylvania Forge flanges are made of specially selected open-hearth steel. They have a tensile strength of 60,000 pounds per square inch — nearly three times that of cast-iron.

Pennsylvania Forge flanges have as much ductility as the pipe itself. When the pipe expands or contracts, the flanges expand and contract in an equal proportion, eliminating all chance of breakage or leakage.

Many flanges break with the last turn of the wrench. This cannot happen with Pennsylvania Forge flanges. Pull up the bolts as tight as you please. You cannot injure the flange no matter how much pressure you apply.

The process of manufacture makes it impossible for Pennsylvania Forge flanges to have any structural weakness such as blow holes or other hidden defects of any kind.

Pennsylvania Forge flanges may SEEM to cost more in the beginning, but they actually cost less in the long run. Write for prices.

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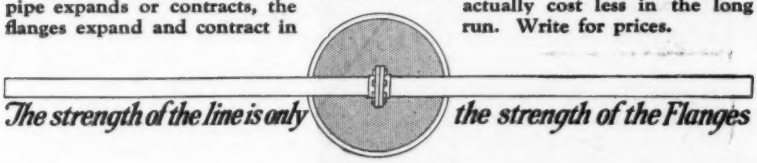

PENNSYLVANIA FORGE CO.

PHILADELPHIA

Texas Branch: **Harrisburg Pipe & Pipe Bending Co., Houston, Texas. Carries full stock of flanges.**

Mention Where You Saw the Advertisement

Contributing Factors to Corrosion

(*Continued from page 33*)

finery equipment, it may be suggested that if the chief petroleum products, gasoline, kerosene, lubricating oil and fuel oil, are not sufficiently freed from sulphur serious damage may result to motors, machinery, silverware and other material.

The first appearance of sulphur when distilling an oil of this grade is usually detected around 400 degrees F.; that is, near the end of the gasoline fraction. Its presence here may be due to very small quantities of hydrogen sulphide in the crude or to the decomposition of closely related substances. This decomposition is caused by heat and by the action of certain acids on the sulphur compounds in the oil and in the metal.

Corrosive Combination

Hydrochloric acid is one of the products obtained when calcium and magnesium chlorides are heated in the presence of water. These Chlorides are often found in oil. The acid forms hydrogen sulphide when it combines with sulphur, which it is suggested, may be found here both in the oil, the metal used in the still, towers, condensers, etc.

Probably the combination of hydrochloric acid and sulphur is responsible for most of the refinery corrosion. This acid does not react on the metal at elevated temperatures but as the vapors cool and condense in the presence of wet steam or water, it becomes active. The concentrated acid is a gas easily soluble in water. The dilute acid is much more energetic in its action on metals than the pure acid. Damage to condenser equipment often follows as a result of the formation of hydrochloric acid. Removal of all water, when the temperature in the condensers falls below 212 degrees F., as it collects in the condensers should be practiced. That is, the water should not pass from coil to coil and to the receiving house together with the product, but should be collected in a trap as soon as condensed and then taken from the box through a direct line. Continuous flow of the acidulated water through the condensing system means unnecessary action on the metal and needless consumption of the cooling units from the condenser water.

The larger quantities of sulphur found in the lubricating oil and the fuel oil residue represent the compounds, such as sulphates, which are not easily broken up by heat. If the temperature is quite high, as when reducing to coke or when the oil is burned as fuel, the sulphur may be liberated in various forms depending on local conditions. Hydrogen sulphide may be formed in the absence of air, but when enough air is present the oxides and acids of sulphur are produced.

The corrosive action of sulphur may proceed in several ways. A direct combination of iron and sulphur forms iron sulphide. Under some conditions this combination is often followed by contact with a dilute acid, and then extensive corrosion results in a very short time, because the iron sulphide is easily acted upon by even very dilute acids. The sulphur may combine with other elements to form compounds which have corrosive properties. The sulphur oxides and the sulphur acids belong to this class.

Corrective Measures

Deposits of the element sulphur are often found in parts of the refinery units. These yellow masses should always be removed. When sulphur is melted and brought into contact with hot iron, a combination sets in at an exceedingly rapid rate and the resulting sulphide renders the iron useless. Hot spots may be produced in this way.

The corrective measures, as applied to the Mid-Continent oils, are chiefly of the neutralizing type. These are in the main confined to the use of alkaline materials, such as lime, ammonia, caustic soda, soap powders and lime stone. Water will remove some sulphur from the crude when it is in the form of small quantities of hydrogen sulphide. The purification of the crude before it reaches the still, if possible, is always advisable. Passage of the oil through the alkaline solution, either by means of a tower or separator

Tank Car Leasing!
from 25 Cars to over 2,000 —
This photograph shows an airplane view of North American's Coffeyville Kan., car shops—where privately owned cars are placed in top-notch shape and where North American cars are kept that way.
Other shops, together with extensive bulk and loaded-car storage facilities are maintained at Chicago, Tulsa and New Orleans.
Service and service alone is responsible for North American's progress. Write for full details
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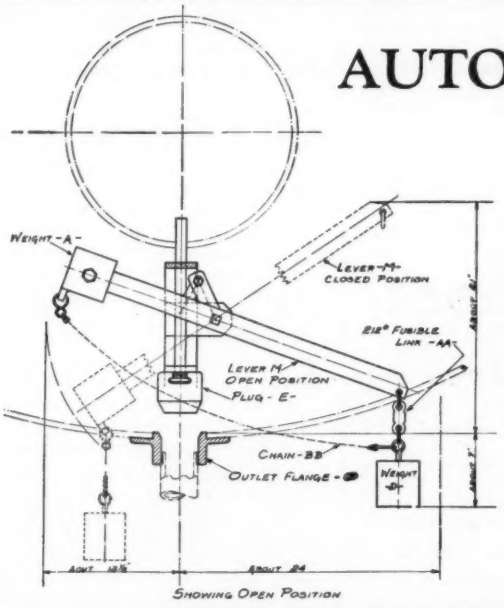
CHICAGO TULSA NEW ORLEANS

OCECO PRODUCTS
on the Stills



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AUTOMATIC TAR PLUGS

THIS is the protection every still needs. Then, in case of a tar line fire the contents of the still are not emptied into the fire.

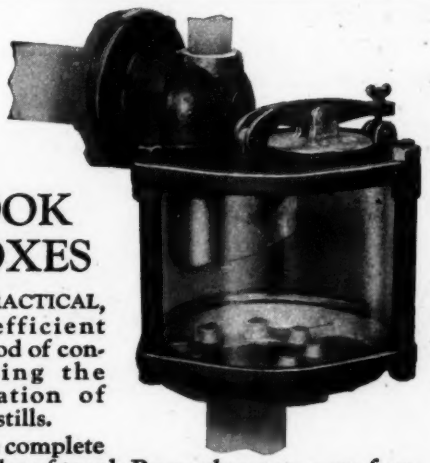
Stop cocks do not protect—when a line breaks the oil begins to burn *immediately* with the result that a man cannot get to the stop cocks to close them.

The only sure protection is an automatic tar plug.

STILL SAFETY VALVES

A THOROUGHLY efficient unit that provides for the relief of both excessive pressure and vacuum within the still.

Furnished for any vacuum desired and pressures up to 30 pounds.



LOOK BOXES

A PRACTICAL, efficient method of controlling the operation of your stills.

The complete cylinder of tough Pyrex glass gets away from the old breakage troubles and gives an entirely unobstructed view of the stream.

Send for the Oceco Catalog containing full description of these units and other equipment which will save you money.

THE OIL CONSERVATION ENGINEERING COMPANY

877 Addison Road — *Headquarters for Tank Equipment* — Cleveland, Ohio

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Beaumont Export & Import Co., Beaumont, Tex., and Tampico, Mex.

OIL TANK **OCECO** EQUIPMENT

SAVES EVAPORATION AND PREVENTS FIRE

system, will in many cases be found effective and economical.

When the objectionable form of sulphur is produced during the process of distillation, it will be necessary to add the neutralizing material to the still or into the tower. Ammonia is ideal for use in the still because of its volatile properties. It will, however, form sulphates which, if permitted to accumulate, may result in hot spots on the still bottom. The other alkalies when used in the still are subject to the same objection. The other alkaline materials are used in solution in water and under the conditions of ordinary still temperatures, the water of solution is evaporated; but as the temperatures are not high enough to carry off the solids, caustic soda, ammonia sulphate, sodium sulphate, etc. remain in the still. These may be removed by cleaning, which should include thorough washing and draining. If the conditions are carefully observed, together with frequent tests, the deposition of the chemical salts may be controlled, so that hot spots or secondary damage need not occur because of them.

It has been an extensive practice to control corrosion by using extra thickness of metal and to replace the parts when the walls become so thin as to be near the danger point. Numerous combinations of alloys have appeared on the market which have been invented for the purpose of retarding refinery corrosion. Many of these special metals possess real merit while some appear to have no advantage over ordinary material. A large number of corrosive resisting metals have been studied by Wilson and Bahkle and they have reported* that the high nickel-chromium steels, some special bronzes and calorized iron stand up remarkably well. Commercial bronze, brass, and low chromium steel showed high losses. The special alloys cannot be extensively used because of the expense, but they should be considered for new installations and for replacements.

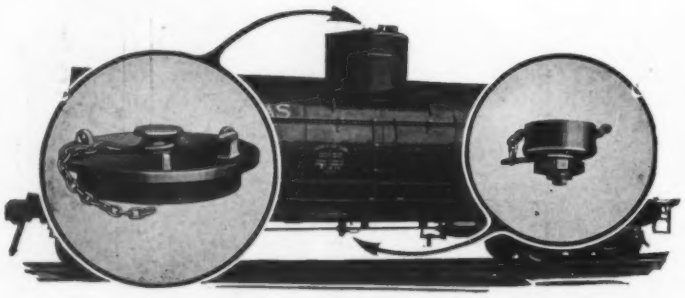
*Jour. Ind. & Eng. Chem. 17; 355, 1925.

Toronto and Baltimore Call on Wichita!

Recent improvements at Toronto and Baltimore refineries necessitated special equipment made to exacting specifications.

We were awarded this business for two reasons; first, because investigation showed our bubble decks and caps already in use by other refineries were giving exceptionally satisfactory results; second—the character of Real Service for which we are nationally known.

Mighty good reasons why you should get better acquainted with us.



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OIL WELL RIG IRONS AND REFINERY EQUIPMENT

Western Iron and Foundry Co.

Wichita, Kansas

Tests Made to Determine Specifications of Various Products

(Continued from Page 20)

equally applicable to the fire point, so it will not be further considered.

Concluding Remarks

These few thoughts on this limited group of tests illustrate the importance, for intelligent specification writing, of a proper understanding of the factors underlying and influencing the test methods, and their results, as well as the necessity of a thorough knowledge of the properties of the oils themselves.

In other words, before setting down anything in a specification, the question to be asked and answered is "What is the significance of this test and its results as regards the use this oil is to be put to?" This relates primarily to the consumer's side of the matter.

On the other hand the refiner in set ting forth the characteristics of his products in sets of specifications must also bear in mind these underlying principles and by suitably varying the items of specification used in dealing with various consumers employing similar oils differently, he can skillfully adjust the specifications of his products and his statement of their properties so as to best meet the properly thought out requirements of his customers.

Thus both producer and consumer of petroleum products will have their interests advanced and each will be benefited by a careful study of the characteristics of oils and the variations of these characteristics with varying conditions, and of the principles underlying the figures used in constructing specifications.

Alfred Wright, newly elected secretary of the Pacific Gasoline Company, with headquarters in Los Angeles, left that city early in January for a business trip to New York. Mrs. Wright accompanied him.

ASSISTANT CHEMIST

Wanted immediately for large refinery near Mid-Continent field. Must be University graduate with experience of testing petroleum products and general analytical work. Young man preferred. Pesonal interview will be required before engagement. Write giving full particulars including age, details of education and experience, and list of references to Box No. 333. Care The REFINER.

SIL-O-CEL
HEAT INSULATION

YOU CAN STANDARDIZE ON EQUIPMENT INSULATION

EVERY insulating requirement of heated equipment is provided for in five forms of Sil-O-Cel. You do not have to stock a different kind of insulation for each different type of equipment. Sil-O-Cel Standard brick, for instance, the most economical form of insulation for tanks and still tops, also answers the special structural and temperature qualifications required of insulation used in retort settings and boiler furnace walls. The other forms of Sil-O-Cel are C-22 brick, for use where temperatures behind the refractory may reach 2000 degrees; Sil-O-Cel C-3 for furnace bases and for making monolithic insulating concrete; Sil-O-Cel plastic cement, and Sil-O-Cel insulating powder.

CELITE PRODUCTS COMPANY

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OFFICES AND WAREHOUSES IN PRINCIPAL CITIES
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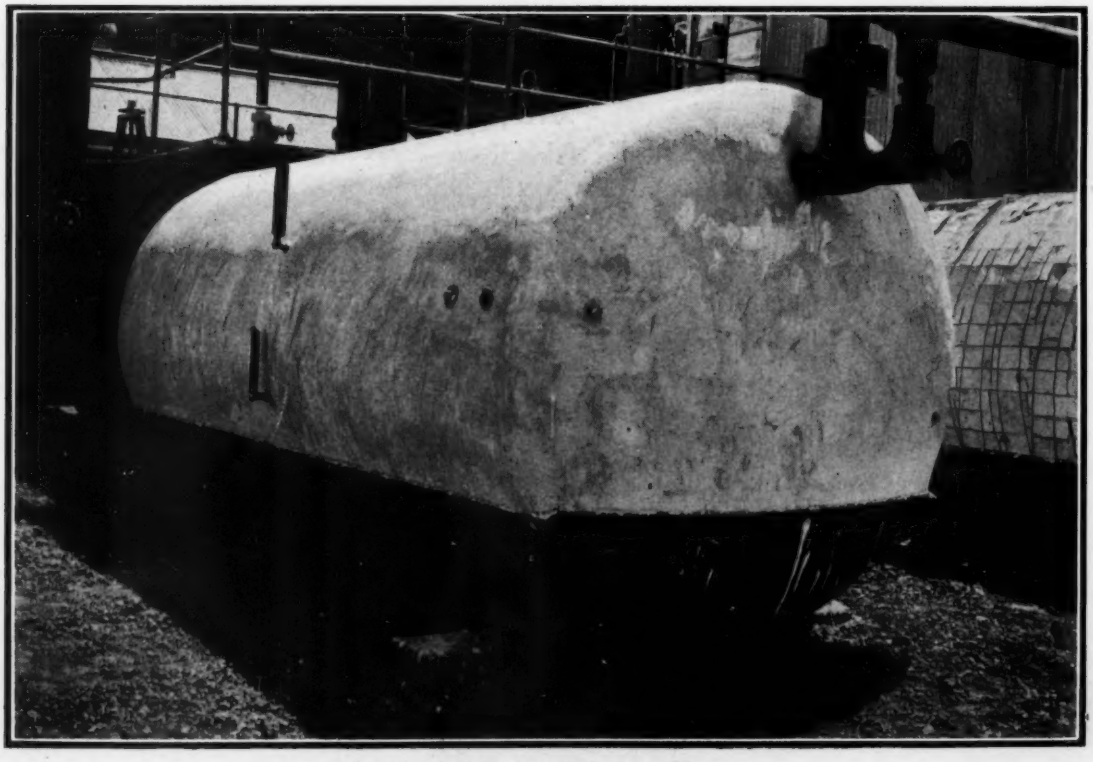
CELITE PRODUCTS CORPORATION, WINDSOR HOUSE, LONDON, S.W.1, ENGLAND.

Applying Sil-O-Cel insulation on charcoal absorbers in a California Natural Gasoline Plant. Defiance Ashestos Co., Huntington Park, Cal., Contractors.



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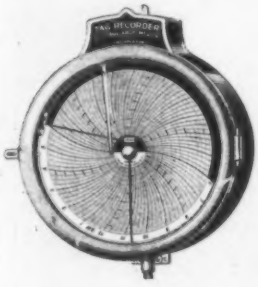
THE REFINERY SUPPLY COMPANY

TULSA, OKLAHOMA

Largest Scientific Material House in the Southwest



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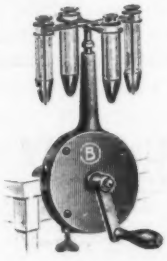

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THE JOS. W. HAYS CORPORATION
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CO, CO_2 and Draft Recorders

COMPLETE REPAIR SHOP
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AT
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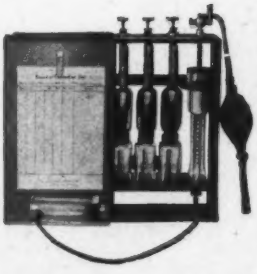

Larger and Complete Refining Units Revealed by U.S. Census

Washington, D. C.—A tendency toward centralization in the refining industry is shown by a census of refining plants just completed by the Bureau of Mines. Making a count as of January 1, it was found that there were 509 refining plants in the United States in 1926 as compared with 541 on the same date in 1925.

Of the 509 refineries counted January 1, last only 352, with a capacity for treating 2,560,000 barrels a day, were in operation; 157, with a total capacity of 290,000 barrels a day, being shut down. In addition, two refineries with a probable aggregate future capacity of 5,000 barrels per day, were under construction.

The 1925 census showed the 541 refineries then existing to have a capacity of 2,827,000 barrels, with six plants, with a total capacity of 37,000 barrels a day, under construction.

Texas, with 100 refineries of 555,000 barrels capacity, leads in number of refineries, although outranked in total daily capacity by California, which has 84 completed refineries of 716,000 barrels capacity. New Mexico, with six refineries, and Montana, with 13, showed the largest proportionate increase in the number of refineries over that of a year ago. This was due mainly to developments during 1925 in the Artesia and Kevin-Sunburst fields.

Of the total number of completed plants, 289, of 830,000 barrels capacity, are skimming plants making gasoline, kerosene, and gas and fuel oils. The greater part of the remaining capacity is that of complete plants, the relative percentage of which is steadily increasing. Approximately 150 plants have cracking equipment, the total charging capacity of which is probably in excess of 900,000 barrels per day.

Comparison of this census with those made by the Bureau of Mines in previous years discloses the trend of the refining industry toward centralization and its adjustment to economic changes. The period 1919-1920 was one of high prices for refined products, gasoline reaching 30 cents, tank wagon prices, in New York, or approximately 75 per cent over the price today. Then followed a period of great expansion of refinery capacity, so that on January 1, 1920, 99 refineries were reported as building, compared with two on January 1, 1926. The price reductions of 1921 and the increasing competition of following years caused the abandonment of many partly constructed plants and the cessation of operations in many completed ones. These now stand as rusting monuments to this period of optimism, and it is estimated that 40 of them of approximate capacity of 60,000 barrels per day have been dismantled or junked during the past year.

The growth in number of small skimming plants is incompatible with the present keen competition in the refining industry, the Bureau points out. Such plants exist today by reason of local advantages or discoveries of flush production in fields remote from pipe lines. As such conditions are gradually disappearing, it is probable that the peak in the number of refineries in the United States has been passed.

The results of this census are given in "A Directory of Petroleum Refineries in the United States, January 1, 1926," compiled by G. R. Hopkins, petroleum economist, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

Hanlon Buys Three More Texas Plants

Breckenridge, Texas.—The purchase of three natural gasoline plants by the Hanlon Gasoline Company, subsidiary of the Chestnut & Smith Corporation, during February added approximately 18,000 gallons of gasoline to the company's present production in the Mid-Continent. These plants are located in Stephens County, and include the first one erected in the county.

The largest of the trio of plants was obtained from The Texas Company, who pioneered the natural gasoline industry in Stephens County in 1920. This original plant is located on the J. W. Parks land, section 3373, T. E. & L. survey, and is equipped to handle a maximum of 10,000,000 cubic feet of gas daily, with a current output of 8000 gallons daily. This deal was made in the nature of a lease covering a period of 99 years. The Texas Company is to receive $200,000 cash annually for five years, and after five years an annual rental of $500 is to be paid for the remaining 94 years. However, if payments are defaulted, the plant automatically reverts back to the original owner. The bulk of the gas used by this plant comes from oil producing wells owned by The Texas Company, and this gas is to continue going to the plant. The residue gas from the plant is used in making carbon black.

The Hurbar Gasoline Company's plant on the Gandy lease, section 34, T. & P. Railway survey, block 8, and the Hurley-Texas Gasoline Company's plant on the Stephenson lease, section 14, L. A. L. survey, with a combined daily production of 10,000 gallons of gasoline daily were taken over by the Hanlon Gasoline Company February 12. The consideration involved in the purchase of these two plants was not made public.

Another Plant For Panhandle Section

Amarillo, Texas.—The Phillips Petroleum Company is moving in materials to erect its second natural gasoline plant in the Carson-Hutchinson County oil and gas field. This plant will be a standard type of absorption, and will be equipped to handle in excess of 20,000,000 cubic feet of gas daily, with an anticipated yield of about 10,000 gallons of gasoline daily. A plant site consisting of 64 acres on the Johnson Ranch, Mary Whitley survey, Hutchinson County, has been purchased. The plant completed by the Phillips Petroleum Company in the south end of the field in Carson County several months ago is now on production, and the gasoline is pumped via three-inch welded line to Panhandle, which is the nearest railroad shipping point. The new plant in Hutchinson County will deliver its gasoline production via this line, requiring about 27 miles of pipe.

Cracking Units For Waggoner Refinery

Electra, Texas.—The Waggoner Refining Company, which is operating a skimming plant near Electra, with pipe line connections to the Electra and Wilbarger County fields, is to install a cracking process to operate in connection with the Electra plant, and will also erect a natural gasoline plant in the Noble-Dyson field, Wilbarger County. The type of cracking units is to be selected early in March.

Contract has been made with Hirt & McDermott, construction engineers of Fort Worth, for the erection of a four million cubic foot absorption gasoline plant at Rock Creek crossing in the Noble-Dyson field. This plant will be equipped with four 80 H. P. Bessemer engines, using the fire and steam process, with vertical stills. A gasoline yield of more than 6,000 gallons daily is anticipated. The production will be delivered to the Electra refinery via a three-inch pipe line, about 15 miles in length.

Methods Used In Extending Credit*

By F. H. Bowman
Pure Oil Company

FULTON DUPLEX
SENSITIVE VACUUM REGULATOR

On a system discharging gases to a line, under light vacuum, it is sometimes desirable to maintain atmospheric pressure.

For this purpose, we manufacture the DUPLEX VACUUM REGULATOR, which acts as a safeguard when used on the vapor lines connected to storage tanks, for the recovery of the gases, the purpose being to prevent the pulling of a vacuum.

WRITE US FOR FURTHER INFORMATION

CHAPLIN-FULTON MFG. CO.
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Oil Refinery Tankage
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BOILER TUBES
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SMITH COAL and COKE

Immediate Shipments from Tulsa Stock
PHONE O-1146 OR WRITE BOX 1926.

CONTRARY to the belief of many, the real function in credit extension work is to find a basis for an extension of credit rather than to find a reason for not extending credit. The common idea of a credit department's function, which seems to be the turning down of orders, reverts to the time when there were no credit departments. The extension of credit at that time was based on the opinion of the president, or chief executive of the seller, or upon the statement from the head bookkeeper about the buyer's experience in liquidating his account. Formerly the extension of credit was handled by a combination of executives, sales force, and accounts. Later, part of the head bookkeeper's work was watching the accounts and approving orders, making him a sort of a credit man.

Now, in nearly every corporation of any consequence, the credit department is a segregated unit having charge of the customers' ledgers and all functions to do with credits and collections of customers' accounts, tying in with the Accounting Department by balancing its accounts and bills receivable. The Credit Department in order to hold up its end of the business is obliged to specialize so that it is able to analyze all the sources of information which are needed to determine the amount of credit.

The Credit Department tries to prevent as many losses as possible. However, too small a percentage of losses shows an unbalanced condition and lack of good judgment. A Credit Department may bring their losses to such a point, by continually disapproving orders, that the losses in Bad Debts will amount to such as infinitesimal percentage of the sales that they will not be noticed. Nevertheless, this subnormal condition will reflect in the general overhead through the additional cost in sales expense to such an extent that this is impractical. This additional sales cost is brought about by extra trips and other expenses necessary to find customers who will pass the muster of such a Credit Department. A Credit Department must take legitimate chances and "play ball" at all times with the Sales Department.

Requirements Flexible

As credit is the basis for the greatest percentage of business today, a Credit Department must function entirely in accord with the policy of its Company at the time the matter of credit exten-

*Paper read before the American Petroleum Institute at the Los Angeles meeting.

NATURAL

GASOLINE

DEPENDABLE SERVICE

BECAUSE OF THE GENERALLY IMPROVED QUALITY OF NATURAL GASOLINE, IT HAS FOUND A READY MARKET WITH REFINERS, NOT ONLY FOR USE IN THE MANUFACTURE OF ORDINARY U. S. MOTOR FUEL, BUT IS BEING EXTENSIVELY USED TO IMPROVE THE HIGHER GRAVITY "EXTRA QUALITY" GASOLINES

CHESTNUT & SMITH CORPORATION

GENERAL OFFICES CHESTNUT & SMITH BLDG.
TULSA, OKLAHOMA.

Keeping Watch Over Condensing Water Temperatures

Efficient refineries keep an accurate check on the temperature of water in cooling towers because if the temperature is high here it means a loss in the product which might otherwise be prevented.

There is no better way of knowing immediately any increase in temperature than with

Bristol's Recording Thermometers

They are accurate and dependable and warn you in time to prevent any of your gasoline from going back with the residue gas.

Our sales engineer will recommend the instrument best suited for your requirements.

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FOR 36 YEARS — Ask Any Technical Engineer — MAKERS OF

BRISTOL'S RECORDING INSTRUMENTS

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sion is broached. For instance, when the Sales Department is exceedingly anxious to move goods, the Credit Department must dig very deeply in order to find some basis for allowing the goods to be shipped on open terms.

Information concerning the buyer is the problem to be worked out. This information must be reliable, must be complete, and must be from varied sources. Then one will check with the other, making all the sources coordinate to the point of extending or not extending credit.

Ask the Man

The salesman is the first point of contact with the customer, be it by personal call, telephone or telegraph. We will take the personal call as a basis, as telephone and telegraph orders should be handled in the same way.

Of course, the best source of information is the buyer himself. The financial statement is commonly offered as a basis, and may nearly always be obtained if requested in the right way. The approximate amount of credit which will be required if the customer purchases his maximum requirements from the buyer should be specified so terms may be fixed to meet these requirements and keep the buyer within the proper credit limit.

Banking connections should be specified and trade references given by the buyer. A call should be made by the salesman on the banker given as reference. There, in addition to general information, he may obtain trade references, if he will approach the banker in the proper manner and explain his reasons for seeking this information.

Any observing salesman may also obtain additional trade reference by glancing at trade signs, or trade-marked goods, around the place of business. All this information should accompany the Salesman's Report on a New Customer sent in with the first order.

Office Duties

When this report is received by the Credit Department, inquiries should be sent out to a bank other than a customer's: to both Commercial Agencies —Dun and Bradstreet: and then to each trade reference listed in the report.

The reason for inquiry from a bank other than the customer's is because, especially in small communities, a banker financing a concern will be prejudiced in his opinion as to the customer's net worth. In a great many cases he will be over anxious to see that his client obtains a liberal line of credit so that the bank's obligations may be liquidated quickly at any time by transferring the indebtedness from the bank to his various creditors.

The reason for using both Commercial Agencies is because very often there is a difference in rating or idea of net worth. This will often disclose some discrepancy which will show up in other sources of information.

The trade references obtained by the

salesman, disclose through the exchange of ledger information, the line of credit that the customer is now being extended and how he is paying his bills. Any favoritism or crookedness in paying some creditors at the expense of others will show up if your trade reference list is adequate. This source is very essential, a really vital factor in determining a line. Of course the ideal way to handle this would be for the Oil Industry to have a Clearing House and then transcribe all ledger experience to each member of the industry who is interested in any common customer.

For various reasons it does not seem feasible for this industry to operate such a Clearing House, but the Interchange Bureau of the National Association of Credit Men has such a plan in operation in most other industries. After you have heard Mr. Moran's explanation of this arrangement there certainly will be discussion enough to bring about a Nation-Wide Petroleum Group of the Interchange Bureau.

Watch the Papers

Another important source of information is the trade papers. Frequently news, either in a personal item or in a technical discourse, will give the Credit Department an idea that something is being done by one of his customers which should or should not be done.

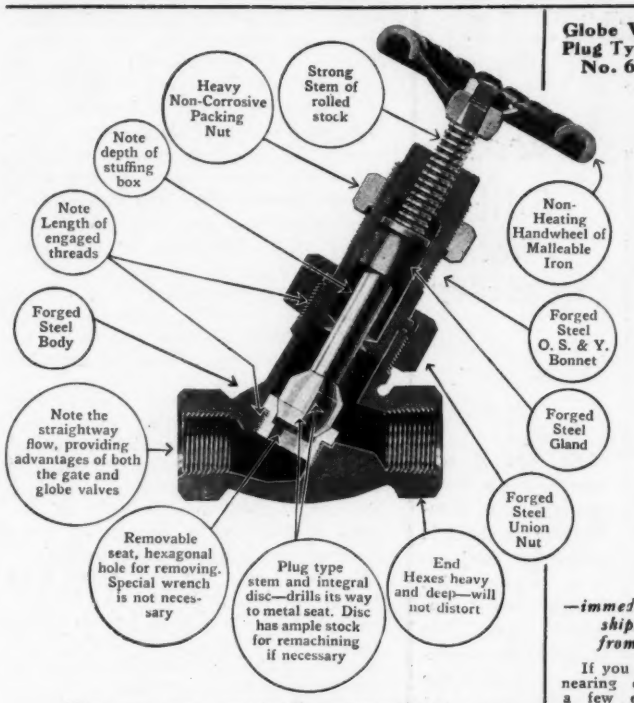
Then the last and greatest source is the personal acquaintanceship wherever possible. Some time ago a very efficient Sales Manager of an Oil Company was rather at swords points with the Credit Department of the same Company. The breach became wider and finally a representative of the Credit Department went to the District and called on the Salesman's customers. The Sales Manager was very much surprised at the reception given the Credit Manager, and the apparent ease with which the Credit Man obtained all essential information from the customer. This was entirely due to manner of approach. Since that time the attitude of this Sales Manager with his Credit Department has been different.

Wherever possible a financial statement should be obtained from a customer. It is very desirable if the line of credit runs into real figures, to also obtain an operating statement.

Next the Analysis

After the information is assembled the analysis begins. The Credit Department in the Oil Industry is fairly certain whether the products purchased are for re-sale or consumption. The analysis of course in each case is different. If the customer is going to re-sell, the turnover and how it is to be resold, serves as a basis for credit, or a real analysis of an operating statement.

Edward Forged Steel Valves


Globe Valve
Plug Type
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Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
Note depth of stuffing box
Note Length of engaged threads
Non-Heating Handwheel of Malleable Iron
Forged Steel Body
Forged Steel O. S. & Y. Bonnet
Note the straightway flow, providing advantages of both the gate and globe valves
Forged Steel Gland
Forged Steel Union Nut
Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
End Hexes heavy and deep—will not distort

Here are two outstanding reasons why you should standardize on Edward Forged Steel Valves.

(1)—designed and built for service up to 500 pounds pressure and intermittent temperatures to 1100° degrees F.—they therefore will fit any service need within this range.

(2)—because of quantity production these high grade valves are priced LOW ENOUGH to justify their use even in service far below their maximum rating.

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Representatives in all principal cities

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If you have a plant nearing completion—a few extra valves needed for last minute installation—an emergency arises where valves are needed quickly—wire Edward—specify "Forged Steel Valves"—immediate shipment will be made—any quantity—and any size from ¼-inch to 2-inch inclusive.

Edward Forged Steel Valves are made in both Globe and Angle pattern—Plug Type or Edward Protected Seat and Disc.

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Manufacturing Distributors in Great Britain

SHORT & MASON, Ltd., London

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In case of the consuming customer, his financial statement is generally the basis for extending a line, credit limits are based on integrity and net worth.

Integrity is the real keynote to all extension of credit. A man's character is always disclosed by his business dealings. A corporation's method in paying bills and carrying out contracts reflects the real inside of its personnel.

The net worth is obtained by scrutinizing a financial statement, throwing out all fictitious assets or assets of indeterminable value deflating physical assets to practically a re-sale basis, and deducting all liabilities, except capital stock.

In the oil industry there is a large volume of business passing through brokers' hands. Some companies refuse this business. However they are a part of the business and credit extension to this class of trade should be based on their ability to pay and their intention to repudiate or stand by contracts according to the turn of the market. Terms of sale enter into the credit limit on the basis of the ratio of time to the amount of credit required. In other words a sight draft customer might be placed on open terms, provided he would pay his bills each week, whereas, if he demanded thirty-day terms or four weeks' business, he would be entirely out of line for an extension of credit.

Earnings a Key

The financial statement requested by buyers in the oil industry should be very simple in form, as the customers buying from three to ten carloads per month are usually the ones to whom this financial statement will be sent. As a rule such customers do not keep an elaborate set of books and complicated forms of financial statements only worry them. Larger customers generally publish their statements.

Regardless of the fact that a Company does not show a very large net worth or have a big showing in fixed assets, the earnings will reflect efficient or inefficient operations in the use of limited capital, provided an operating statement may be obtained. This statement will show the volume of business, the profits and the distributions of expense which is taken out of the business for operation, showing what is left to accumulate to surplus. Whenever possible it is desirable to have two consecutive years comparison as this will very clearly indicate the trend of operations for the company.

It is quite essential that adequate insurance be carried; especially in a business with a small capital doing a large volume of profitable business, it is generally advisable to carry "Use and Occupancy" Insurance.

The size of the concern and the volume of products purchased makes a great deal of difference how much further a Credit Department will go in analyzing a business.

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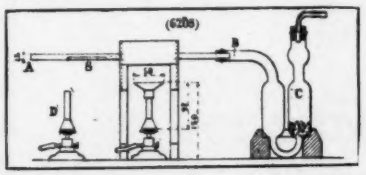
EXTRACTS OF REFINING TECHNOLOGY

Distilling Oil Shale—Steam is obtained from a boiler which surrounds a furnace or kiln in which oil shale, mixed with limestone, lime marl, or like material, is burnt, the oil distilled from the oil shale also being recovered. The boiler surrounds a number of flared tubes, which are connected at their top ends with a bunker, in which a mixture of oil shale and limestone or marl in given proprotions is heated by the combustion gases of the fuel previously dropped into the tubes from the bunker. The oil that is distilled from the oil shale in the bunker is collected through a pipe.

The proportion of limestone, etc., to oil shale which is used in the process prevents sintering and is as follows. With furnace tubes of 25 centimeters mean diameter, sixty parts by weight of shale and 26 parts by weight of lime. With furnace tubes of 45 centimeters mean height, sixty parts by weight of shale and twelve parts by weight of lime, the calorific values of the shale being 1200 units. With shale having a calorific value of about 2000 units, the proportion of lime was increased in the first case to about forty parts by weight and in the second case to about twenty parts by weight. The residues from the furnaces are worked either directly by milling, with or without the addition of other materials and a second burning, or the burnt shale separated from the residue is used for the manufacture of cement by the well known process. British Patent Application No. 21899 of 1924.

* * *

Sulphur Content Determination of Mineral Oils—The determination of the sulphur content of benzines and petroleums is effected with ease by means of the lamp method, but in the case of the heavier petroleum distillates recourse has been had to the Berthelot-Kroeker bomb method which, while giving good results, is time-consuming. The method which is described in the Chem. Weekblad., 1925, pages 98-100 is a more rapid one and is applicable



to such products as gas oils, light fuel oils and lubricating oils. As far as the heavy oils and the asphalts are concerned the results obtained by this method are lower than the bomb method figures. Hence a method has been sought which will give good results and this method consists in vollatilizing the oil in a quartz tube which serves as a contact medium, the tube being traversed by a current of air. The sulphur is burnt and converted quantitatively into sulphur dioxide and is then received in a solution of hydrogen peroxide (three percent concentration,) and the acid formed is then titrated with a solution of sodium hydroxide, one-fortieth normal. The entire operation takes twenty minutes. This method can be applied with good results to all petroleum products, to kerosenes, asphalts and cokes.

The apparatus is seen in the accompanying illustration. AB is the quartz tube about forty centimeters long with an interior diameter of one centimeter.

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In the heating zone for a distance of one centimeter fragments of quartz (5x 5x2 millimeters) are placed one on top of the other. These enhance the combustion process. The vapors of the petroleum product, which have first been admixed with the required quantity of air, come in contact with the incandescent surfaces and are completely burnt. The pieces of quartz must not occupy more than a fraction of the zone of incandescence in order not to impede the progress of the combustion process. The absorption apparatus is connected at B. The combnustion furnace is made of aluminum and is lined internally with asbestos.

The absorption apparatus contains forty cubic centimeters of the hydrogen peroxide solution. The top connection is connected with an air pump and about two litres of air are first passed through the apparatus. Then the burner is lighted and shortly the tube is heated up to incandescence. The oil or petroleum product that is to be analyzed is then introduced into the tube in a porcelain boat which is seen in the figure. The oil is volatilized, vapors are burnt, the sulphur being converted into sulphur dioxide which is absorbed in the hydrogen peroxide and thereafter the solution is titrated with standard alkali to determine the percentage of acid formed and this is then calculated back into terms of sulphur.

* * *

Determination of Water in Hydrocarbon Oils, Etc.—In the Journal of the Institute of the Petroleum Technologists, 1925, pages 471-4 there is contained a description of a method which may be used for establishing the proportion of water in hydrocarbon oils, shales and lignites.

A sufficient quantity of oil is taken as a sample so that it will give less than half a cubic centimeter of water when it is distilled with toluene or xylene. The distillation is carried out in a flask that has a capacity of 150 cubic centimeters and that is provided with a bent tube which leads to a measuring tube. The latter is immersed in a freezing mixture. The distillation is continued until twenty cubic centimeters of distillate are collected. Aniline is then added to the distillation until critical solution is obtained at a temperature of 20 degrees C. The amount of aniline that is employed for this purpose corresponds to the amount of water in the distillate, and this may be read off from graphs which have been prepared for various solvents.

The results that were obtained when benzene was employed as a solvent were not satisfactory. The method may be applied to the determination of water in solids. In each case the results were somewhat higher than those which were obtained by drying in a vacuum. A special method of determination is necessary in the case of

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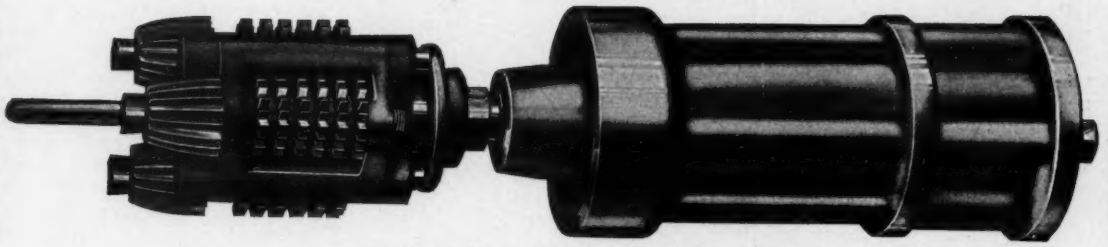

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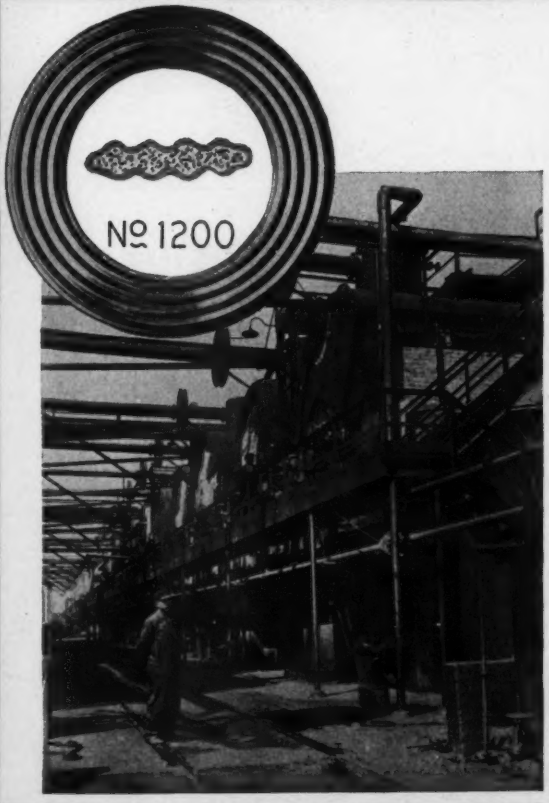

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kerosene or gasoline, as lower boiling fractions distil over with the toluene or zylene, and therefore results are obtained by comparing the anoline required with that required for dried oil to which a given quantity of water has been added.

* * *

Spreading Lubricants on Metallic and Solid Surfaces—The behavior of oils on a surface of liquid mercury resembles that on water. On clean surfaces of steel, brass, and agate, drops of vaseline oil, which contain only saturated molecules, rapidly cover the whole surface, whereas free drops of olive oil remain as globules owing to the attraction between the surface and the oriented active unsaturated molecules. Machinery oil which contains a mixture of saturated and unsaturated molecules shows an intermediate effect. The spreading effect of inactive saturated mineral oils can be neutralized by adding small quantities of active substances, such as cetyl alcohol or oleic acid; by coating the metallic parts concerned with a thin film of active substance. Clocks can be lubricated with pure mineral oil which is unsatisfactory under ordinary conditions due to the speading effect.

For further details see Comptes rendues, 1925, pages 772-4.

* * *

Extraction of Oil Shale, Oil Sand and the Like—The material is extracted with aqueous solutions which contain small amounts of emulsifying substances. Such materials as soaps, alkali resinates and the like are employed for this purpose. These substances affect the surface tension of the solution. They are employed preferably with the addition of substances which are able to dissolve petroleum, such as trichloroethylene, or of causing agglomeration of the oil particles, such as powdered charcoal.

These solutions may be acid or alkaline, and they are maintained at a temperature which is as low as is practical. The material is macerated with a similar solution before it is changed into the extraction bath. The residues are suitable for use in road making. French Patent No. 589,710.

* * *

Distilling Petroleum Oils—Petroleum residues and heavy oils are purified by treatment with strong sulphuric acid at an elevated temperature. Preferably the material is first treated below a temperature of 100 degrees C. and then at not over 200 degrees C., or between 160 and 170 degrees C. Sulphur trioxide may be added to the acid, and a hydrocarbon that is liquid at the temperature used and not acted upon by the acid may be mixed with the crude material. The product is neutralized by treatment with calcium carbonate and filtration through porous clay.

Oil which has been treated once with acid as above may be freed from sulphonated compounds by extraction with alcohols, light naphthas, or other solvent of the pure oil, or by further treatment with twenty percent oleum.

For example, black cylinder oil is mixed with an equal weight of petroleum jelly that has already been treated with acid, and agitated with 1.5 parts of twenty percent oleum (figured on the weight basis) at a temperature varying between 120 and 160 degrees C. for a period of twenty-four hours. The liquid is then drawn off and neutralized by agitating it at a temperature of 120 degrees C. for a period of three to four hours with ten percent porous clay and 1.5 percent of calcium carbonate. Then the treated oil is filtered hot through porous clay.

The carbonaceous residue in the acid treatment vessel is broken up and treated with naphtha, benzol, carbon tetrachloride or other solvent of the purified oil. The solution is withdrawn, the solvent distilled off, and the oil neutralized. and filtered. Alternately the solution is chilled and the precipitated oil or jelly allowed to settle out. The carbonaceous residue is afterwards heated to about 400 degress C. to remove the volatile impurities, ground in a ball mill and maintained red hot on contact with air until about half is consumed. A highly absorbent carbon is thus obtained. Sulphur dioxide evolved during the operations is absorbed in sodium carbonate solution.

Refining Mineral Oils with Tin Halogenoids—According to German Patent No. 421,858 a process has been devised for the purification of mineral oils of all sorts, mineral oil distillates, shale oil distillates, tar distillates and the like by means of tin halogen compounds. These are made to act upon the oils in the finely divided state and these substances are first absorbed by solid pulverized masses such as fuller's earth, infusorial earth, activated carbon, clay, soda, calcium carbonate and the like. When the tin halogenoids are used in this form their very vigorous action on the oils is modified. There is great contact surface between the oils and the refining agents with the result that all resinous and asphaltic substances are readily absorbed.

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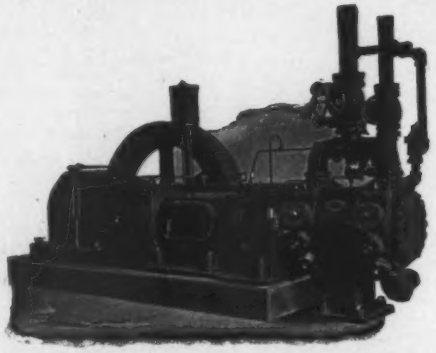

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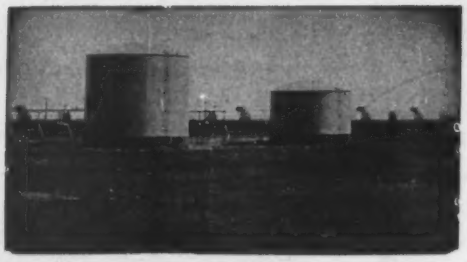

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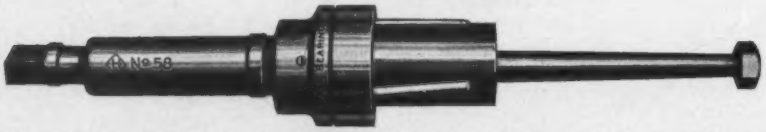

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Decision May Revive Ethyl Gasoline Sale

Washington.—Indications of resumption of sale of Ethyl Gasoline came out of the report of the committee named by the Surgeon General of the United States Public Health Service. The substance of the report was that there are now no grounds for prohibiting distribution of Ethyl Gasoline of the composition specified as a motor fuel.

The report did recommend that use and distribution of the product be under proper regulations.

The filing of the report was the occasion for a number of questions by E. W. Webb, president of the Ethyl Gasoline Corporation, relative to any objections committee members might have to the resumption of sales of the product.

Filing of the report followed several months of investigation. The investigation resulted from the deaths of persons, who were employed in the Bayway plant of the Standard Oil Company (New Jersey) where the tetraethyl lead solution was made.

At the time of these deaths manufacturers contended there was no danger from the gasoline having lead mixed with it.

Tetraethyl lead, as a detonating agent in gasoline, was discovered by the General Motors Research Company. The Ethyl Gasoline Corporation is owned by the General Motors Company and the Standard Oil Company (New Jersey).

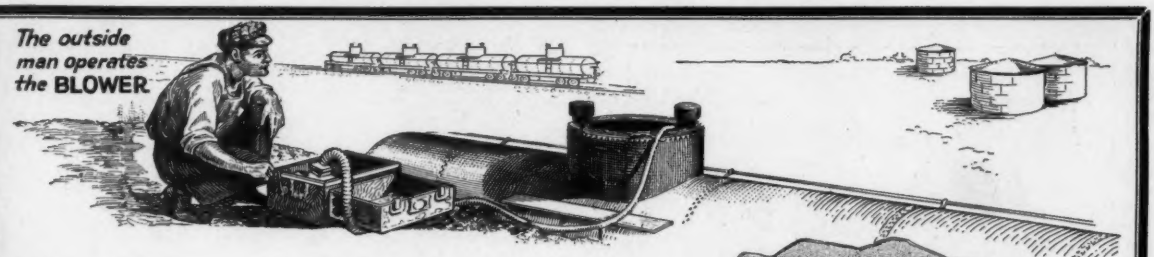
Engineers Combine

The Widdell Engineering Company consulting engineers and general contractors, and Arthur G. McKee & Company, contracting engineers, have formed an association for the conduct of engineering and contracting in connection with the oil refining business. The work of the new combination will include the design and construction of refinery equipment, pipe stills, fractionating towers, treating plants and other similar equipment.

The Widdell company is the successor to the Cross-Widdell Engineering Company and well known in the oil refining trade, while the Arthur G. McKee & Company has for the past 20 years specialized in the construction of blast furnaces, steel plants, rolling mills, coke ovens and the designing and construction of complete equipment for the manufacture of iron and steel, constructing plants in several of the foreign countries.

The corporate entities and structures of both companies will be maintained as at present, the Widdell Engineering Company having its headquarters at 512 American Bank Building, Kansas City, and the Arthur G. McKee & Company headquarters at 2422 Euclid Avenue, Cleveland.

The association of the two companies was made for the purpose of combining the service of both, which with the joint resources will enable the organizations to offer a service impossible for either company operating individually.



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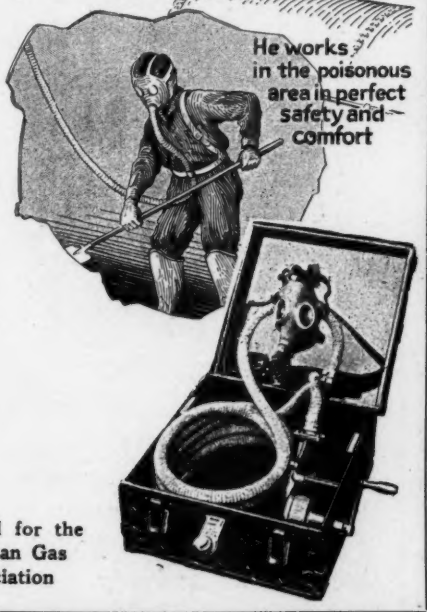

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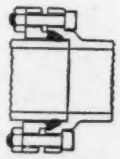
SIMPLEX CAST IRON CONDENSER PIPING



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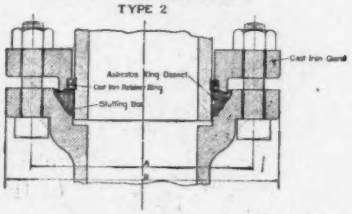
SIMPLEX CONDENSER PIPING
TYPE 2



Dimensions A and B are American Standard for 125 lbs. pressure

AREA PER LINEAR FOOT

SIZE	CLASS	INSIDE SQ. FT.	OUTSIDE SQ. FT.
3	AB	.02184	.04171
	CD		.04671
4	A	.04172	.05600
4	B,D	"	.05169
6	A	.06708	.08639
6	B,C	"	.08169
8	AB	.10944	.11000
8	CD	"	.10440
10	AB	.15092	.15100
10	CD	"	.14600
12	AB	.21116	.20800
12	CD	"	.20280

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